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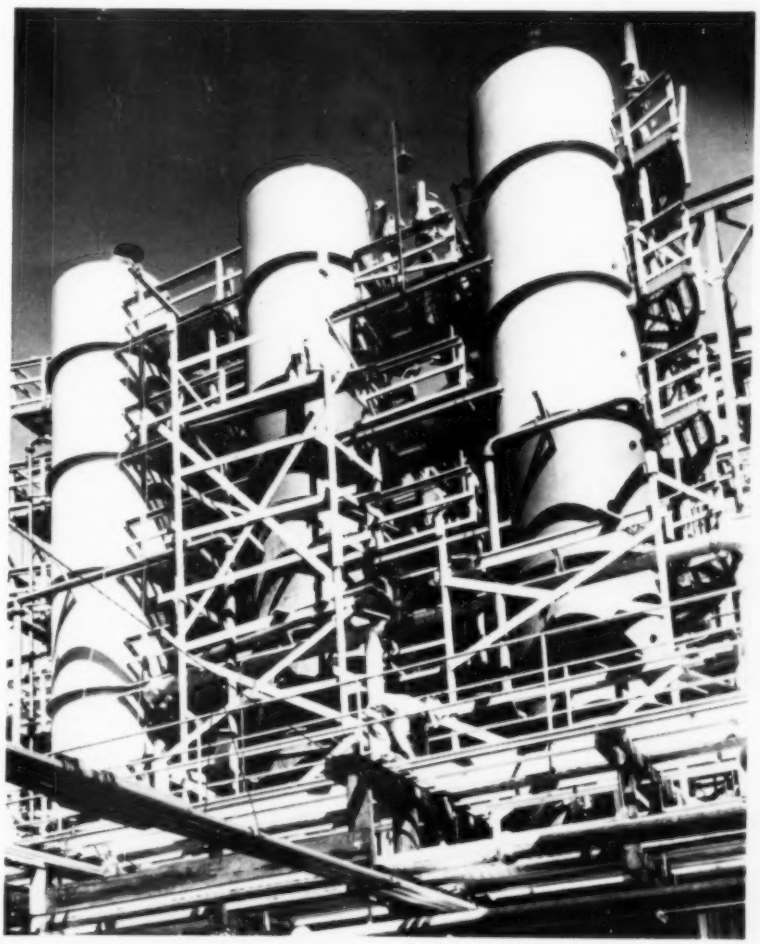
VOLUME 6 NUMBER 9 • NOVEMBER, 1950



Work of reactivation and modernization starts on the first of the nation's stand-by GR-S synthetic rubber plants ordered back into production under government's expanded program. Plant is being reactivated by Naugatuck Chemical Division, United States Rubber Company for Office of Rubber Reserve. It started production on October 12, 20 days ahead of schedule, and when operating at peak capacity will add more than 72,000 long tons annually to nation's rubber supply. Original capacity for plant was 60,000 long tons yearly but modernization will boost this figure by more than 12,000 long tons. Above, workmen check huge stripping columns where synthetic rubber latex is purified.

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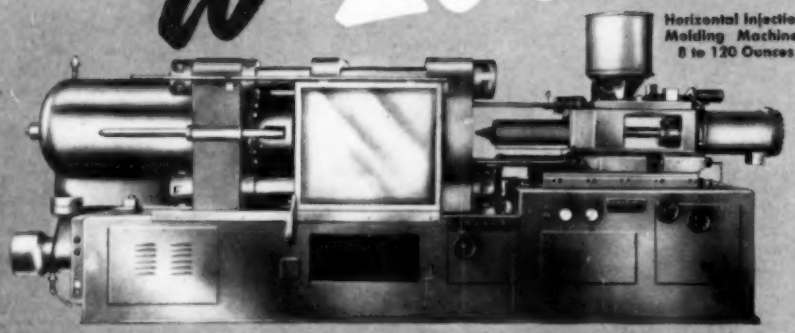

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Personals

At the October 4th meeting of the Board of Directors of Reichhold Chemicals, Inc., Detroit, **Harry Kline**, Manager and Technical Director of RCI's Phenolic Plastics Division, was elected a vice president of the company—in charge of this division.

Dwight L. Turner has been appointed Southern Sales Manager of Arnold, Hoffman & Co. Inc. He will be located at 2130 N. Tyron St., Charlotte, N. C.

Jules A. Jupa, 1006 Madison Ave., Elizabeth, N. J., Stanley W. Jones, Jr., 6 Lebanon Road, Scarsdale, N. T. and Francis M. Ruggles, 8117 N. Waiola Ave., LaGrange, Ill. have been added to the Plastics Department sales staff of the M. W. Kellogg Co.

Leo P. Gajda has just been appointed to the position of Chief Engineer of the Arthur Colton Co., a division of Snyder Tool & Engineering Co., manufacturers of special purpose machinery.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, AND CIRCULATION REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233) Of SPE Journal published monthly, except July & August at Athens, Ohio for 1 September, 1950.

1. The names and addresses of the publisher, editor, managing editor and business managers are: Publisher Society of Plastic Engineers, Inc. 409 Security Bank Bldg., Athens, O. Editor Jesse H. Day, Ohio University, Athens, Ohio. Managing Editor, none. Business Manager, none.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given) Society of Plastic Engineers, Inc., no stockholders. C. Todd Clark President, F. Burkhardt Mfg. Co., 5000 N. 2nd St., St. Louis, Mo.; Islyn Thomas Vice President, 286 Kings Road, Madison, New Jersey; Robert L. Davis Secretary, Southeastern Plastics, Inc., Portsmouth, Va.; W. O. Bracken Treasurer, Hercules Powder Co. Wilmington, Dela.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of the total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semiweekly, and triweekly newspapers only.) /s/ Jesse H. Day Signature of editor, publisher, bus. Mgr. or owner.

Sworn to and subscribed before me this 18 day of September 1950. /s/ Bertha Stickney (my commission expries 5/15/1951.)

A fine program of technical papers is planned for the 7th SPE Conference, Jan. 18-20, New York City.

JOURNAL

Volume 6, Number 9, Nov. 1950

Published monthly except July and August by the

SOCIETY OF PLASTICS ENGINEERS, INC.
409 SECURITY BANK BLDG.
ATHENS, OHIO

Dr. Jesse H. Day, *Editor*

Editorial Advisory Board: MARIO PETRETTI, J. H. DUBOIS, WAYNE PRIBBLE, CARL J. FROSCH

Advertising Representatives: Ortgies & Dillon, 155 East 44th St., New York 17, N. Y.

30 cents a copy **$3.00 a year**

Entered as second-class matter at the Post Office at Athens, Ohio.

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A Few Typical Cross Sections

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IN SHOP PRACTICE

This column will answer all problems whose solutions are not in violation of trade ethics and which do not trespass on restricted techniques.

PROBLEM No. 8

We would like to know what literature or data is available on the effect of electronic heating or pre-heating on the electrical properties of a molded thermosetting part. The F. Corp.

All members and interested persons are invited to submit answers to the problems printed in this column.

Positions Open

Assistant Production Department Foreman in Newark, N.J. area with Tool Design experience and ability to set up efficient production lines for plastic items. Reply stating age experience and salary expected to Box 22J, SPE Journal.

Letter to the Editor

Dear Sir:

I've been writing letters to editors of magazines and newspapers for a long time now, and all of a sudden I find I haven't written to you yet. And that's funny because I've been a member of SPE for seven years plus. Since I haven't invented anything spectacular recently, I'll have to fill this letter in by reporting a conversation I had with the old man. (Not my old man, just an old man. He's a character. More about him later.)

Anyway, like I said, I was talking with the old man, and got around to telling him that I was going to be at the 7th SPE Conference in January 1951, and of course the old man asked me what for. Well, I told him what for—and that's how come this letter.

First, I said, there is the very obvious matter of learning something from the technical papers read at the convention; and even if I happen to learn something outside my own speciality, I figure it won't hurt much. The papers I miss I will get a chance to fill in on from the SPE Journal. The banquet and so on are fun, but especially I'll get a chance to talk to other men in the plastics business; when a bunch of brains get rubbed together, there's bound to be sparks that might turn out to be guiding lights. And there's always the very real pleasure of making new friends; some of them big shots, too. Anyway, I like to make friends and met old friends.

I like people.

Yours, etc.
W. W. Birdsmith

1951 CONFERENCE PLANS INCLUDE SYMPOSIA ON BIG MOLDINGS AND MACHINERY

Partial List of Speakers Hints Program of Wide Interest

The 1951 Conference Committee recently met in New York City to consolidate plans for the 1951 Technical Conference that is to be held at the Statler Hotel in New York on January 18 through 20th, 1951.

Of most interest to everyone is the general outline of speakers which was presented by Edward W. Rowan, Dillon-Beck Mfg. Co., Chairman of the Speakers Committee. Mr. H. V. Potter, managing director of Bakelite Ltd., London will address the group, representing the British Plastics Federation, on the subject "Plastic Situation in Great Britain." Mr. Carl Sundberg of Sundberg-Ferar is preparing a paper on "Better Product Design Through Plastics". "Plastisol" will be the subject of the paper by Mr. C. W. Patton of Union Carbide and Carbon Co. A man from E. I. duPont deNemours, Co., Inc. will discuss "After Treatment of Polystyrene". Mr. H. E. MacArthur of Conforming Matrix Co. will talk on "Spray Painting of Molded Plastic Parts".

Mr. Gordon Thayer of Dow Chemical Co. will discuss "Mold Design." Mr. Frank Carman of the Manufacturing Chemists Association will address the group on the availability of plastics materials. Mr. M. A. Brown, Jr., Plaskon Division, Libbey-Owens-Ford Glass Co., is preparing a paper on "A Family of High Speed Thermoset Plastic Molding Materials".

Mr. Rowan is endeavoring to obtain Mr. Carl Geigus of the Underwriters Laboratories to talk on "Underwriter Laboratories Viewpoint of the Use of Plastics" and Dr. E. S. Ebers of Naugatuck Chemical Division of U. S. Rubber Co.

There are two symposia planned for the conference. "Future of Big Molding—Both Compression and Injection" is being arranged by Mr. Ed Kennedy of Monsanto Chemical Co. Mr. Islyn Thomas, Thomas Mfg. Co., is arranging the other symposium on machinery. He expects representatives from Watson-Stillman Co., Fellows Gear Shaper Co., DeMattia Tool & Machine Co., Reed-Prentice Corp. and Improved Paper Machinery Corp.

There will be the reading of the prize papers from the Prize Paper Contest and Mr. Rowan hopes to develop a program which will aid the individual members of the Society cement their relations with the Armed Forces.

Mr. G. Palmer Humphrey, 366 Madison Avenue, New York 17, N.Y., is in charge of Company Registrations. All companies that register for official representation at the conference will be allowed to register four men without extra charge. Their names and room number will be posted at the registration desk and their names and products will be listed on the official program. Anyone interested should contact Mr. Humphrey for further details.

Mr. Saul Blitz is planning a program for the women who attend with their husbands. Some suggestions have been a sight seeing tour of New York, a tour of Radio City, a breakfast get-together at the B. Altman Department Store followed by a small fashion show and a guided shopping tour, a luncheon at LaGuardia Airport Restaurant followed by a visit to the United Nations at Lake Success.

Facilities for obtaining tickets to the Broadway plays are available through the National Office of the Society of Plastics Engineers, Inc., Athens, Ohio.

Information on advance registration for the conference is expected to go out some time this month. Get your reservations in early.

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THE SPOTLIGHT ON CENTRAL OHIO

COLUMBUS PLASTICS PRODUCTS

Columbus Plastics Products, Inc., celebrated its 12th birthday in October, 1950, with the completion of its latest plant expansion of over 40,000 square feet. This latest addition brings the concern's total floor space to over three acres under roof. Although this additional space will be used primarily for storage of supplies, materials, boxes, and finished goods, it will also permit a substantial step up in production.

The company now operates over 40 injection presses ranging in capacity from one to forty-eight ounces. Approximately 400 people are employed in turning out the company's proprietary line of Lustro-Ware housewares consisting of over eighty plastic items. In addition to the proprietary line of Lustro-Ware housewares, custom molding work is also done for some of the country's largest firms.

In the space of twelve years Columbus Plastic Products, Inc. has grown to be the nation's largest producer of thermoplastic housewares. Designing, engineering, die building, molding, finishing, assembling, packing and shipping are all done from one location with the objective of providing their customers with products of the highest quality. Additional items will be added to the Lustro-Ware housewares line as more plastic material becomes available to molders.

THE IRONSIDES CO.

The Ironsides Company was founded in 1893 and devoted its efforts primarily to the field of industrial lubrication. In later years specialty emulsions were developed for many uses, among which was the application to mineral wool. This led to mineral wool binders, among which phenolic resin occupies a prominent position.

The result of this early development of phenolic resin wool binders was the manufacture of other types of phenolic resins for laminating, bonding and many special applications.

At the present time the Ironsides Company is engaged in four major fields: phenolic resins, industrial lubricants, specialty emulsions and wire weatherproof coatings.

BATELLE MEMORIAL

The Battelle Memorial Institute has been active in the plastics field for some time and is particulaly well represented in Central Ohio Section of S.P.E.

Battelle's research in the fields of chemistry and chemical engineering is extremely diversified. Its technologists are constantly searching for new materials—from alloys to plastics. Virtually all fields of chemistry are served.

The Institute's several research divisions include specialists in unit operations, heavy chemicals, analytical chemistry, surface chemistry, and the various other branches of physical, organic, and inorganic chemistry and chemical engineering. The many projects handled for industrial sponsors have included the development of new synthetic resins and plastics — their production and fabrication.

The laboratories are amply equipped for work in the fields of high pressure synthesis and hydrogenation. Projects have included investigations of catalysis and specific catalysts for organic synthesis and high pressure reactions, and the development of new processes for recovering pure constituents of coal-tar fractions and the exploration of new uses for them.

Improved methods and materials for protecting textiles and wood have received attention, and plasticizers for synthetic rubber, as well as synthetic rubber utilization have been studied.

Paper-making studies have been undertaken in the Institute's paper laboratory. A large printing laboratory has been recently installed.

An outstanding achievement of the electrochemical research laboratories is a process for the electrolytic polishing of metals. The process has a great many industrial applications and makes available at relatively low cost a superior surface finish for most industrially-used metals. Chemical treatments for the brightening of metal also have been developed.

THE
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ACTIVITIES AND ORGIN OF CENTRAL OHIO

By J. W. Knight and L. A. Monaco

In the early part of 1945, Mr. L. S. Shaw, Secretary-Treasurer from Cleveland contacted several of the people connected with three or four of the molders and fabricators in the area from Cambridge to Columbus in an effort to learn what interest, if any, there might be in a section of Society of Plastic Engineers.

On August, 1945, an organization meeting was held at the Granville Inn, Newark, Ohio and the following officers were elected: Charles Ebner (Yardley) President, J. W. Knight (Fabri.-Form Co.) Vice President, R. L. Davis (Continental Can) Treasurer, Miller Sherwood (Continental Can) Secretary. Within a few weeks, there were thirty three members in good standing, eleven of which were transfers from other sections. Things started out with a bang when Bill Stout, internationally known automotive and aircraft designer was obtained for an early meeting through the influence of Owens Corning Fiberglass.

Our present roster is seventy members. These members are all associated with the plastic industry and since we have molders, fabricators, converters, coaters, laminators, and machinery manufacturers, we embrace a broad section of the industry. Several of the members have been privileged to act upon National Committees and hold National Office.

The Meetings are held usually at Newark, but the section tries to mix it up between Columbus and Cambridge. Dinner meetings are held with the business and technical sessions held afterward. Effort is made not to have too many highly technical meetings and several sessions have been devoted to such subjects as patents and plant operating problems. Many plant towns have been scheduled and being on the main trail from East to West, we have some excellent talent for our meetings. Our area is large, running seventy five miles in each direction, North, South, East and West, but the meetings are well attended.

The Present Officers are as follows: Mr. H. W. Kuhlman (Battelle) President, Mr. R. W. Rosel (Yardley Plastics) President elect, R. W. Meyer (Owens Corning) Secretary, and Mr. W. J. Braley (Columbus Plastics Products) Treasurer.

The men you need to know will be at the Hotel Statler in New York on January 18-20.

FACTORS AFFECTING THE CRAZING of POLYSTYRENE[1]

By BRYCE MAXWELL[2] AND L. F. RAHM[2]

The effect of orientation on the critical crazing strain, the reversibility of crazing and the effect of solvents on the crazing of polystyrene have been investigated. It has been found that when the polymer chains are lined up in the direction of tensile stressing, the critical strain is increased in direct proportion to the amount of orientation. Reversibility tests have been performed on samples allowed to recover for various times at room temperature and also at elevated temperatures. It has been found that craze-cracks regain some of their original strength when allowed to recover at or above 82°C. Many representative organic solvents have been tested for their effect on the critical crazing strain. These results are tabulated and the conclusion is drawn that the resulting reduction in critical strain is the result of a plasticizer action by the organic solvents.

INTRODUCTION

The crazing of polystyrene is affected by many factors. The conditions under which the specimen has been fabricated, its thermal and strain history prior to testing and the conditions under which it is tested or used all have a marked affect on the resulting crazing. In order to understand the phenomenon of crazing as many of these factors as is practicable must be investigated.

In an earlier paper[3] the authors described a method of quantitatively measuring the amount of crazing in standard A.S.T.M.[4] tensile specimens. Referring to Fig. 1 a specific beam of light (a) is directed on one of the flat sides of the tensile specimen. Since the crazing cracks always form perpendicular to the tensile strain, they will reflect the light beam into the light meter at (b). The greater the area of crazing cracks the greater the intensity of the light falling on the sensitive face of the meter. Accordingly the response of the light meter may be taken as a quantitative measure of the amount of crazing.

Using this technique it has been found that for clean, thermal strain free specimens a mechanically applied tensile strain of approximately 0.75% must be reached before crazing will start. It has also been found that this critical crazing strain is independent of temperature below 82°C, the second order transition temperature for this material. The earlier report also described the effect on this critical strain of some environmental and strain histories. It is the purpose of this paper to elaborate on these effects and to describe in some detail the results of further rheological studies of the crazing of polystyrene.

Four separate characteristics of crazing have been studied and are described in the following sections. The first is the method of growth of the cracks, including the effect of strain. The second is the effect of orientation on the critical elongation. The reversibility of crazing has been investigated to determine whether or not the material regains any of its original strength when the cracks close up, and finally the effect of organic solvents has been studied. The final section contains the conclusions to be drawn from these studies.

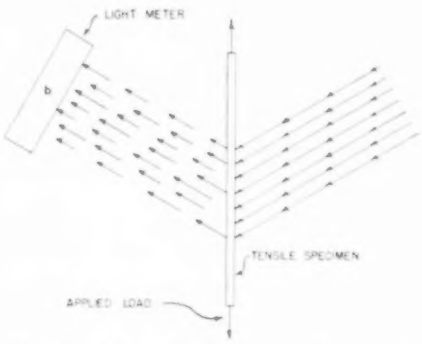

Fig. 1. Schematic diagram of crazing measuring equipment.

I. GROWTH OF CRAZING CRACKS

When a specimen of polystyrene is subjected to a tensile load, it will stretch. Part of this stretch or elongation is considered to be purely elastic, corresponding to an elastic straining of the bond angles and the unwinding of chains; the other part of the elongation is inelastic in the sense that it is not immediately reversible when the load is removed. Ultimately, if sufficient time is allowed at no load the elongation is completely reversible.

When a specimen which is clean and free from thermal strains is stretched to 0.75% elongation crazing cracks begin to form on the surface of the specimen. These cracks are always planes perpendicular to the direction of the tensile stress. If the specimen is held at some load that gives a strain above this critical crazing strain, the cracks will grow. This has been shown by measuring the light reflected from the crack surfaces during creep tests. The greater the amount of light reflected the greater the area of the cracks.

In order to determine whether it is stress or the strain which causes the cracks to grow, tests were performed at constant strains above the critical value. The results are shown in Fig. 2. Referring to curve (1), a sample was strained to 0.82% and held at this constant strain while the sample crazed. The crazing (shown as foot candles) was studied as a function of time.

Starting at point A the crazing went through an initiation period during which the rate of crazing increased. After about 75 minutes the rate of crazing began to decrease until a definitely slower rate of crazing was reached at B. This indicates that for

The work reported here has been sponsored jointly by the United States Army, Navy and Air Force under Signal Corps Contract No. W-36-039-sc-32011.

[2] Plastics Laboratory, Princeton University, Princeton, N. J.

[3] B. Maxwell and L. F. Rahm, Rheological Properties of Polystyrene Below 80°C; Industrial and Engineering Chemistry, 41, pg. 1988, Sept. 1949.

[4] American Society for Testing Materials, Designation: D 624-44.

a specific strain there is a maximum amount of crazing that can be reached.

At point B the strain was increased and then held constant. The crazing rate immediately increased but after about one hundred minutes it again reached a very slow rate. The strain was again increased at points C and D with similar results. Microphotographs were made of the surface of the specimen during this test. Fig. 3 (a) shows the surface a few minutes after the first strain has been applied. Fif. 3 (b) shortly after the second increase in strain and Fig. 3 (c) after the third increase in strain. From a careful study of these photographs it will be seen that after each increase in strain new cracks appear. During any cycle of constant strain the cracks that were started by that strain grew, but no new cracks appeared until an increase in strain was applied.

It is interesting to note that the bright sloping line at the bottom of the pictures is composed of the crazing cracks which formed along a scratch on the surface of the material. Even though the scratch is not normal to the tensile stress the crazing cracks which form along it are normal to this stress.

Curve (2) of Fig. 2 shows the growth of crazing when a specimen is held under constant load sufficient to give an initial elongation of 0.82%. In this case, which is really a creep test, the elongation is continually increasing at a rate which is approximately inversely proportional to log time. This means that not only are the original cracks growing but new cracks are continually forming since the strain is increasing. Therefore we may conclude that in general for any given strain there is a definite number of crazing cracks which will be formed. This indicates that 0.75% is the strain at which the first crazing cracks start. In order for more cracks to form the sample must be further strained.

It has been postulated that the crazing cracks start first in regions in which the general orientation of the polymer chains is normal to the direction of the applied strain. This means that at 0.75% elongation the chains that are oriented in the direction normal to the strain pull apart. At higher elongations crazing appears in regions where the chains are less generally lined up in the direction normal to that of loading.

At any given strain it takes time for the cracks to grow to any appreciable size. Therefore in a standard stress train test if run at high speed the surface will be covered with a light blush of cracks. If the test is run at a low rate of loading the crazing cracks will be much larger. This theory has been confirmed by observations of samples broken at high and low rates of loading.

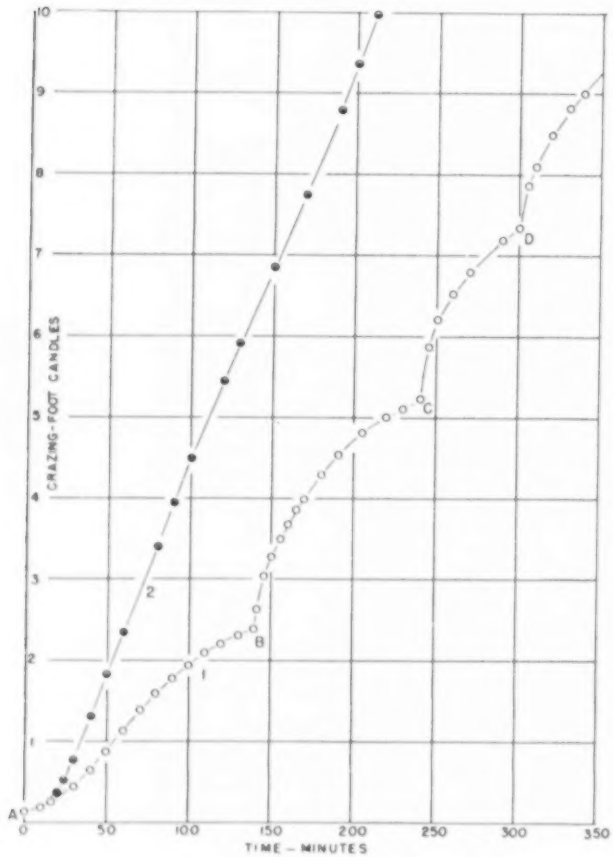

Fig. 2. Effect of amount of strain on crazing rate.

II. EFFECT OF ORIENTATION

In order to determine the effect of orientation on the critical crazing strain, samples of polystyrene were given various amounts of orientation and then subjected to a test for critical elongation. The method of orientation is as follows. A sheet of polystyrene 7"x11"x$\frac{1}{8}$" rigidly clamped between file faces at the top and bottom is suspended in an air circulating oven. A ten pound weight is attached to the lower clamp. The oven is rapidly raised to a temperature of 135°C. At this temperature the material is soft enough to flow under the applied weight. When the sheet has elongated the desired amount the heaters are turned off and the oven cooled down. A slight shortening of the sample takes place after it has reached 80°C.

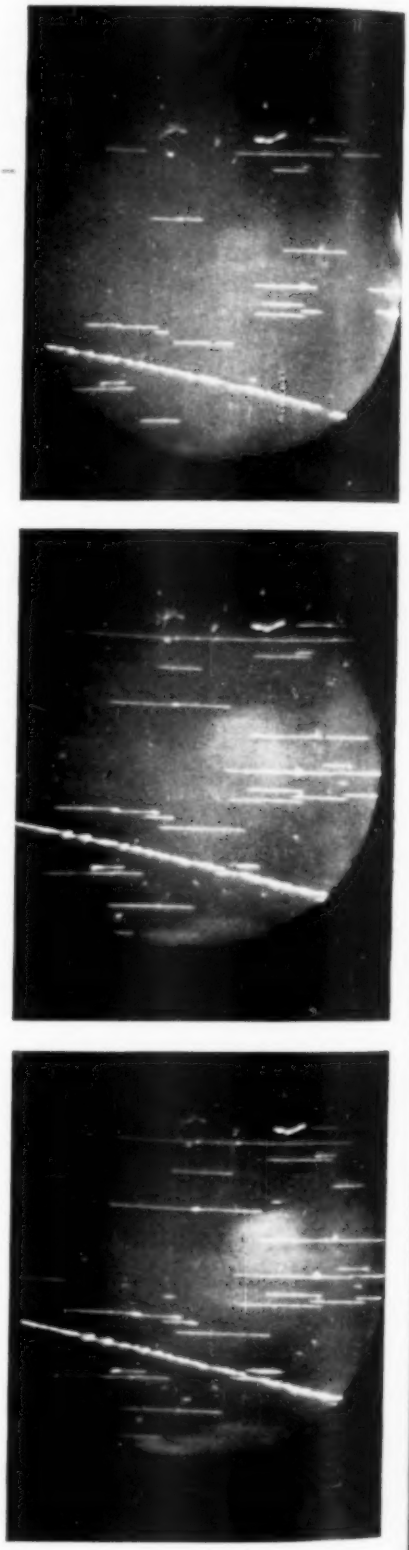

Fig. 3. Mico - photographs of crazed surface at various strains.

Fig. 4. Crazing vs stress, showing initiation of crazing.

This is considered to be ordinary thermal contraction. The degree of orientation is taken as the apparent elongation expressed as percent. By this process sheets were prepared with apparent strains ranging from zero to 114%. There was no obvious difference in the appearance of the sheets of varying degrees of orientation but under polarized light they showed different colors. The center portion of each sheet is of one uniform color while the ends exhibit many spectra. Standard tension type specimens were cut from the center section of each sheet, the long axis of the specimen corresponding with the direction of orientation.

Several methods have been devised to measure the critical crazing strain. The most convenient is by first determining the stress strain properties of the material and then testing a fresh specimen by the light meter method for the stress at which crazing starts. By plotting the log of the candles vs. the applied stress as in Fig. 4 the stress at which crazing starts may be readily determined. The critical crazing strain can be found from this stress and the stress strain curve, provided the same rate of loading is used in each case.

Three samples each of four degrees of orientation were tested for critical crazing strain. The results are shown as line (A) in Fig. 5. An approximately linear relation exists between the critical strain at which crazing starts and the amount of orientation as measured by the apparent strain given to the material at 135°C. For no orientation but with heat treating the critical value is 0.96% and for 114% orientation it is 1.26%. Point C represents the critical strain for the sample when not heat treated.

Specimens were also tested with orientation normal to the direction of testing. No significant variation from the 0.96% value was found in these. We may conclude that in unoriented samples there are regions in which the chains lie generally in a direction normal to the applied stress and it is in these regions that crazing starts at the lowest strain. If the material is given an orientation in the direction of tensile loading, the general orientation in the weaker regions is more in the direction of straining and a higher strain must be reached before crazing begins.

Crazing is really the beginning of failure in polystyrene. When a crack appears it reduces the area over which the stress is distributed and causes a large local stress concentration. Since crazing is dependent on strain we should expect that the ultimate strain would vary directly with the critical crazing strain. Line B in Fig. 5 shows the variation of ultimate strain with orientation, while point D represents the ultimate strain for a sample given no heat treatment. It appears that the ultimate strain follows a relationship parallel to that of the critical crazing strain. This gives added confirmation to the theory that crazing is the pulling apart of chains in the region where they lie most generally in the direction normal to the applied strain. It also confirms the belief that crazing is the beginning of ultimate failure.

III. REVERSIBILITY OF CRAZING

If a specimen has been crazed by subjecting it to a tensile stress, some of the crazing cracks will disappear when the load is removed. This first disappearance is almost instantaneous and is analogous to an immediate elastic recovery. With time a further recovery in crazing takes place at a gradually decreasing rate. This closing up of the crazing cracks must be caused by the pulling together of the surfaces by the polymer chains in the region near the cracks as they try to reform in their normal coiled configurations when the load is removed.

In order to determine, upon disappearance of the cracks, whether or not any of their original strength is re-

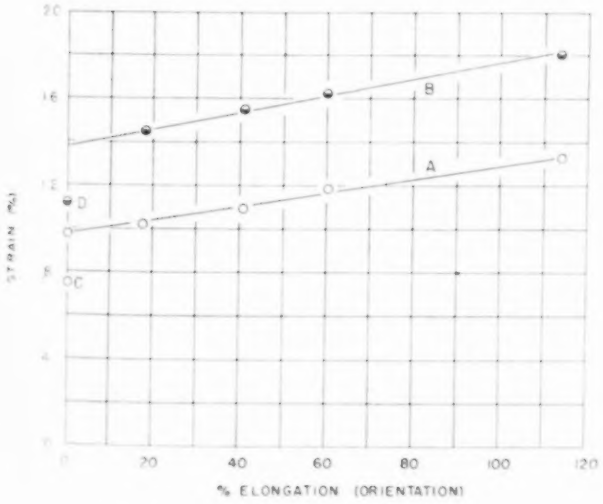

Fig. 5. Effect of orientation on critical crazing strain and ultimate elongation.

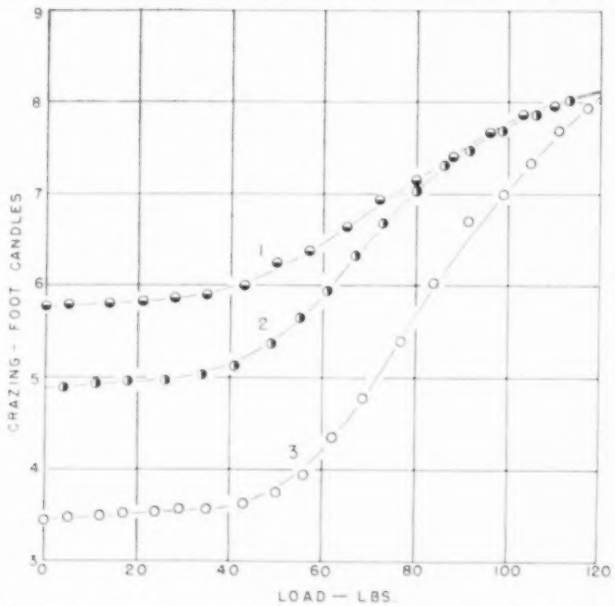

Fig. 6. Reappearance of crazing following long and short time recover.

covered the following experiments were performed. A tension sample was loaded at room temperature until it crazed to a value of about eight foot candles. The load was then removed and the crazing allowed to recover for ten minutes. After this period of recovery the sample was loaded at a slow constant rate while the crazing was studied as a function of the applied load. See curve (1) Fig. 6. Up to about thirty pounds no significant reformation of the crazing cracks took place. As the load was further increased the cracks began to reappear until at about 110 pounds all the original crazing cracks had reopened. Another sample, curve (2), was tested the same way except that two hours, at no stress, were allowed for recovery. A third sample, curve (3), was allowed to recover for twenty-two hours. It is apparent that at longer times of recovery a higher load is needed to reopen the crazing cracks. At first glance this would indicate that crazing is reversible, that is, the cracks appear to regain some strength after they have closed up. This is not necessarily the case since curves (2) and (3) probably represent a shifting downward of curve (1) on the crazing scale due to the additional amount of crazing that has recovered. That is, allowing more time for crazing to recover, merely shifts the crazing curve downward, and does not appreciably change its shape or shift it along the load scale.

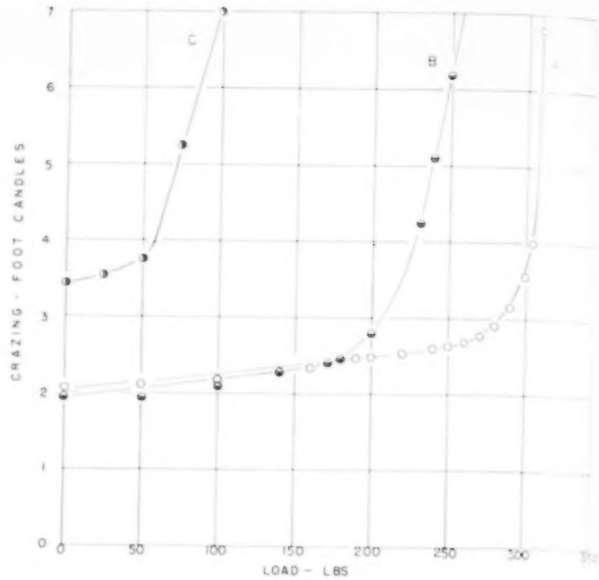

Fig. 7. Reappearance of crazing following thermal recovery.

For the crazing cracks to recover any of their strength there must be a cohesive force formed between them when they close up. Meissner and Merrill[5] have shown that even for a small cohesive force to be formed between two surfaces of polystyrene at room temperatures a large pressure must be applied. Therefore it seems unlikely that any of the original strength of the polystyrene is recovered.

However, at a temperature above the second order transition coalescence is much easier. Therefore if the sample is heated after the removal of the first load we should expect it to regain some strength and the crazing cracks should not reappear so readily. This is shown in Fig. 7. Curve A shows the crazing vs. load for the virgin material. After this load was removed the sample was heated for thirty minutes at 82°C. After cooling to room temperature the sample was again loaded and the crazing plotted as a function of load (curve B). Curve C is the 22 hour curve of Fig. 6 redrawn for comparison. It will be noted that the heating to 82°C has greatly increased the strength of the cracks so that they do not begin to reappear in any quantity until a load of 175 lbs. is reached. The heating has shifted the crazing curve of 22 hours recovery to the right along the load scale indicating that the cracks have regained some of their original strength.

IV. EFFECT OF SOLVENTS

It has been found that certain organic materials such as alcohols, hydrocarbons and even something in finger prints reduce the critical crazing strain to about ⅓ of its value for clean samples. The effect for kerosene has also been reported by Bailey.[6]

There are two possible mechanisms by which such materials promote crazing. Perhaps these materials leach out some low molecular weight polymer from the surface of the polystyrene leaving it in a strained condition which permits cracks to form at a lower elongation. The other suggested mechanism is that the organic material acts as a plasticizer reducing the forces between chains so that they may be pulled apart readily.

About ninety organic materials have been investigated for their effect on the crazing of polystyrene. To test this number of materials by the determination of critical crazing strain method would take a prohibitive length of time. A more simple method used was as follows. Clean strips of polystyrene 8"x1"x⅛" were prepared. A drop of the organic material to be investigated was placed on the center of the strip. The strip was then bent so that the side with the organic material on it was in tension. If the material under the drop crazed before the surrounding material as the strain was increased it indicated that the organic material reduced the critical crazing strain.

The results of these tests are shown in Table I. The first column lists the

[5] Meissner & Merrill, "Coalescence Behavior of Some High Polymers" Modern Plastics April, 1949.

[6] James Bailey, Modern Plastics, 24, 2, 127 October, 1946.

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materials to be evaluated. The next column gives the effect on the critical elongation. If there is no reduction in the critical strain, 0 is shown, 1 indicates a slight effect, 2 indicates a strong effect and 3 a very strong effect. That is, the higher the number the lower the critical strain or the more readily crazing occurs. These various degrees were determined by eye and therefore are qualitative. All the organic materials tried reduced the critical elongation except glycerol, trimethylol propane and styrene trimer. The glycerol did not seem to wet the surface of the polystyrene. The dilute inorganic acids did not appear to promote crazing but concentrated nitric had a slight effect.

In the third column of Table I with the title "After Evaporation" the materials marked with an asterisk showed a reduction in the critical strain even after the organic material had evaporated. Those marked with a - sign were found to be as good as new after evaporation. All those materials which evaporated without softening the surface of the polystyrene left the surface as craze resistant as the original clean surface. Those materials which softened the surface caused the critical elongation to be reduced.

Most of the alcohols and many of the other materials which in the liquid caused a reduction of the critical strain did not have any permanent effect on the polystyrene. That is, when applied to a fresh piece of styrene and then allowed to evaporate these materials do not have any effect. From this we must conclude that organic materials reduce the critical strain at which crazing starts by a plasticizer action and not by a leaching action. If it were a leaching action, the critical strain would remain low after the organic material evaporated. Those materials which softened the surface left the critical elongation low, but the very fact that the surface was soft indicates that some of the organic materials did not evaporate and were left behind to act as a plasticizer.

V. CONCLUSIONS

From the studies of oriented material we may conclude that the critical crazing elongation increases with the amount of orientation in the direction of the applied strain. An orientation of about 115% raises the critical strain to about 1.3%. An elongation of approximately 0.75% is the critical value for unoriented material and this may be assumed to be the minimum critical value when the polymer chains are lined up in a direction normal to the direction of the applied load. This assumption is justified since the samples intentionally oriented normal to the direction of loading did not show a lower critical strain.

With regard to the reversibility of crazing it seems to be evident that at room temperature crazing is not reversible. When the load is removed the cracks tend to close up or become invisible due to the normal strain recovery of the unbroken material, but the process is not truly reversible. That is, when the cracks close up, the material does not regain any noticeable strength. But it must also be concluded that heating a sample to its second order transition temperature causes the cracks to regain nearly all of their original strength.

From the work on the effect of organic materials on crazing we may conclude that nearly all organic liquids reduce the critical elongation but that this reduction is caused by a plasti-

TABLE I

	Effect of Liquid	After Evaporation	Remarks
ALCOHOLS			
Methyl	1	–	
Ethyl	2	–	
N-Propyl	2	–	
Iso-Propyl	2	–	
N-Butyl	2	–	
Tert-Butyl	2	–	
Iso-Butyl	2	–	
N-Amyl	2	–	
Iso-Amyl	2	–	
N-Hexyl	2	–	
N-Octyl	2	–	
Cyclo Hexanol	2	–	
Furfuryl	2	–	
Benzyl	2	*	Softens surface.
HYDROCARBONS			
N-Pentane	2	–	
Hexane	2	–	
Benzene	2	–	Softens surface.
Benzine	2	–	
Toluene	2	*	Softens surface.
Kerosene	3	*	Doesn't evaporate.
Lubricating Oil	1	*	Doesn't evaporate.
High Pressure Grease	1	*	Doesn't evaporate.
HALOGENATED HYDROCARBONS			
Trichloroethylene	1	*	Softens surface.
Ethyl Bromide	1	*	Softens surface.
Carbon Tetrachloride	1	*	Softens surface.
Bromobenzene	1	–	
Chloroform	1	–	
1-4 Dichlorobutane	2	*	Softens surface.
Sec-Butyl Bromide	2	*	Softens surface.
Benzo Trifluoride	2	*	Softens surface.
ALDEHYDES & KEYTONES			
Formaldehyde	1	–	
Acetone	2	–	
Methyl Ethyl Ketone	2	–	Softens surface.
Paraldehyde	2	–	
Cinnamaldehyde	1	–	Makes surface white.
ACIDS			
Acetic	2	–	
Oleic	2	*	Doesn't evaporate.
Lactic	1	*	Doesn't evaporate.
Levulinic	1	*	Doesn't evaporate.
Nitric (dil.)	0		
Hydrochloric (dil.)	0		
Nitric (conc.)	1		
Sulfuric (dil.)	0		
AMINES			
N-Butylamine	2	–	
Triethylamine	2	–	
Triethanolamine	1	*	Doesn't evaporate.
Heptylamine	2	*	Doesn't evaporate.
Ethylenediamine	2	–	
Dibenzyl Amine	1	*	Softens surface.
N-Amylamine	2	–	
Decylamine	2	*	Affects surface.
ETHERS			
N-Hexyl	3	–	
N-Butyl	3	*	Softens surface.
Ethyl Ether	2	–	
B.B. Dichloroethyl Ether	1	*	Softens surface.
Phenyl Ether	2	*	Softens surface.
N-Propyl	2	*	Softens surface.
MISCELLANEOUS			
Neatsfoot Oil	2	*	Doesn't evaporate.
Castor Oil	1	*	Doesn't evaporate.
Styrene Monomer	2	*	Doesn't evaporate.
Polystyrene Trimer	0		Doesn't evaporate.
N-Butyl Mercaptan	1	–	
Para Cresol	1	*	Doesn't evaporate.
Butyl Carbitol	2	*	
Glycerol	0	–	
Ethylene Glycol	1	*	Doesn't evaporate.
Pyridine	2	*	Softens surface.
Ethylether Acetate	2	*	Softens surface.
Aniline	1	*	Softens surface.
Propylene Glycol	1	*	Doesn't evaporate.
1-4 Dioxane	2	*	Softens surface.
Trimethylol Propane	0		Doesn't evaporate.
Silicone Grease	1	*	Doesn't evaporate.
Ethyl Orthosilicate	2	*	Doesn't evaporate.
Diethyl Phthalate	2	*	Softens surface.
Polyethylene Glycol	1	*	Doesn't evaporate.
Tri-ethyl Ortho Formate	2	–	
Dithio Diglycol	1	*	Doesn't evaporate.
Diethyl Maleate	1	*	Softens surface.
Acrylonitrile	2	*	Doesn't evaporate.

cizing action and not by a leaching action. That is, the organic liquid enters the polystyrene sample reducing the attractive forces between the polymer chains so that they can pull apart at a lower strain.

The results of all experiments to date indicate that crazing is due to the pulling apart or breaking of the material, starting in the regions where the orientation of the chains is most generally in a direction normal to the direction of straining. Apparently it is easier to pull the chains apart in a direction normal to their axes than it is to slide them past each other in a longitudinal direction.

From these conclusions we may derive some principles of design which will be of assistance in preventing crazing in molded components. First of all, the maximum permissable tensile strain should be limited to 0.75%. This value of strain is satisfactory for polystyrene which has not been exposed to any of the organic materials listed in Table I. In cases where exposure to organic materials cannot be avoided the same limiting tensile strain may be used provided the material is treated with one of the protective surface coatings now available for this purpose.

NITRILE RUBBER TALK AT ROCHESTER

By C. F. VAN EPPS

Mr. Richard Dudley, Enjay Company, spoke to the Rochester Section of SPE about "Nitrile Rubber in the Plastics Field" on October 16. He talked briefly about the molecular size, shape, composition, and structure in relation to the physical and mechanical properties of the modified rubber. He also outlined some of the work done by Enjay Company on the development of superior impact resistant molding.

The Enjay Company has done considerable work on improving phenolic plastics through the use of acrylonitrile rubber and some of the compounds have remarkable toughness as molded plastics. Mr. Dudley is the development and service engineer for the company, which is an affiliate of Esso Standard Oil.

CHROME PLATING DISCUSSED AT MEETING OF WESTERN NEW ENGLAND SECTION

By WESLEY S. LARSON

Mr. Logozzo prefaced the showing of movies on chrome plating with a few remarks on the necessity for good preparation for plating. Strains in steel from annealing and machining will show up in plating. Poor hardening technique and heavy machining technique will cause such strains. Poor hardening leaves free carbon which will affect plating. A common difficulty is the drawing of steel at too low a temperature. Pieces heat treated at 1600 to 1800 F should be drawn well over 250 F. Amorphous areas in steel will show in plating. In polishing, the greatest fault is lack of enough polishing after hardening. Parts should be stoned with 240, 320, and 500 grit in sequence, if necessary. It is important to lubricate during stoning and polishing. Do not drag surface of steel when buffing; it causes surface strains. All defects magnify in plating. A .005 chrome plate can be put on regular surfaces but not on sharp corners. Plating thickness of molds is generally determined by material to be used. The gates and corners should be heavier than surfaces which have less wear.

Chrome plating is also widely used for many other industrial uses. An example is the salvage of threads; a coarse thread may be built up .004 to .005. Chrome plating is also used for adjusting fits and for chrome plating taps and drills to reduce friction. When used for steel, the plate is .0003 - .0004 and when used in plastics, the plate is .0015 - .002. Chrome plating is very brittle and should not be used on impact surfaces.

Two moving pictures were shown in color which were taken by the speaker in chrome plating installations on decorative chrome installations throughout Connecticut. The first was on decorative chrome installations where the plating is very thin and practically all work is in production quantities and completely mechanized. Several installations were fully automatic with the exception of loading and unloading the plating racks. Vinyl plastisol is widely used to protect the chrome plating racks and to stop off all areas except the holding pins. A second movie dealt with the chrome plating of molds which is a much more exacting art. Most mold plating requires elaborate anode positioning in order to cause the chrome to deposit in the proper places. A multicavity mold with several hundred small holes was shown in which an anode pin had to be placed in each hole.

After the showing of the movies Mr. Logozzo answered questions from the audience. The comments are summarized as follows:

It is advisable to use a minimum of .001 chrome plate on molds for asbestos and mica compounds and to polish the mold surface after plating. Some experience by group members indicated that chrome plating was not advisable on preform dies. Chrome plating is very corrosion resistant but sometimes it is porous; the surface must be buffed before and after plating and must be very dense to be well plated and consequently corrosion resistant. It is recommended that mold cavities be buffed after plating to eliminate some of the breaking in which is ordinarily necessary. Vapor blasting as a substitute for polishing and buffing is all right but inferior to hand polishing and will necessarily leave a matte surface. Chrome plate will not stand vinyl breakdown with resulting hydrochloric acid. Molds for Kel-F which were chrome plated have given good service but probably were not subjected to any breakdown products. Chrome plated molds used on abrasive type phosphoric acid materials were chrome plated .002" and would withstand 75,000 parts and were then replated. Although chrome is very slippery and good friction material, never chrome both sliding surfaces; exceptions are sometimes allowable if parts are always lubricated. Chrome molds are better for light color compounds and help to keep them clean. Chrome plating prevents oxidation of hot molds when not actually molding.

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REPORT ON THE CAPITAL SECTION BALTIMORE-WASHINGTON

By WILLARD de CAMP CRATER

The history of the Baltimore-Washington Section is a brief one but despite our youth, a strong chapter is evolving. The following will give a birds-eye view of our activities.

On December 2, 1947 a group of 18 individuals in the Baltimore and Washington area met with Mr. T. E. Orr and Mr. J. H. DuBois, National Officers of the SPE, to discuss the formation of a Baltimore-Washington Section. A charter was granted by the National organization on January 21, 1948 and further organizational meetings were held on February 3 and 17.

The first official meeting of the section was held March 23, 1948 at the National Bureau of Standards. Mr. John DeBell, a charter member of our section, was the principal speaker. Mr. J. H. DuBois, the national President of the Society, discussed the objectives of SPE.

Directors to serve through 1949 were elected by a letter ballot of the 53 charter members prior to the second meeting of the section on May 4, 1948. These directors met following the meeting and elected the following officers: President, Gordon M. Kline; Vice-President, Albert M. Stover; Secretary, Albert Lightbody; Treasurer, John B. Alfers; National Councilman, William R. Bailey. Additional directors elected were Willard deC. Crater, Peter King, Frank Reinhart and Walter R. Sykes.

Committees were set up to carry on the work of the section and the following were active through 1949: Professional activities: E. B. Stratton; Membership: W. R. Sykes, assisted by W. deC. Crater and R. E. Eshenaur and Clinton Rector. Credentials: W. deC. Crater, Chairman, assisted by Paul L. Kingsley and Arthur Schroder. Finance: J. B. Alfers, Chairman. Program: Frank W. Reinhart, Chairman, and W. deC. Crater. House: John J. Lamb, Chairman, assisted by John W. Sinner. Publicity: Frank H. Carman, Chairman. Educational: Peter King, Chairman.

Any discussion of our Baltimore-Washington section must inevitably begin with our first President, Dr. Gordon M. Kline. By personal contact and through his many publications, Dr. Kline is known to everyone in the plastics industry.

Dr. Kline is Chief of the Plastic Section, and Assistant Chief of the Division of Organic and Fibrous Materials of the National Bureau of Standards. He has been working in this field practically continuously since joining the Bureau staff in 1929. He has also been Technical Editor of Modern Plastics since 1936 and is Editorial Editor of the annual Modern Plastics Encyclopedia. He is Chairman of the Federal Specifications Technical Committee on Plastics and of Committee D-20 on Plastics of The American Society for Testing Materials. He is a member of the Aircraft Structural Material Sub Committee of the National Advisory Committee for Aeronautics, and the Committee on Plastics and Elastomers of the National Research Councils Advisory Board of Quartermaster Research and Development.

Willard de Camp Crater

Gordon M. Kline

Frank W. Reinhart, Assistant Chief of the Organic Plastics Section, joined the staff of the National Bureau of Standards in 1937. As Assistant Chief, he organizes, supervises, and reviews research and development on organic plastics, coatings, and adhesives where his principle research has been concerned with phenolic resins, lacquers, airplane dopes, reinforced plastics, adhesives, and degradation of plastics.

Before coming to the National Bureau of Standards, Mr. Reinhart was a member of the faculty of Juniata College in Huntington, Pennsylvania where he taught chemistry from 1930 to 1937. While at Juniata he also engaged in research on analytical, physical, and organic chemistry problems.

Mr. Reinhart has written a number of technical papers on styrene, effect of catalysts on plywoods, degradation of plastics, adhesives, airplane dopes, reinforced plastics, and reinforced plastics, and accelerated testing. He is a member of A.S.T.M. Committee D-20 on Plastics, Chairman of A.S.T.M. Committee D-14 on Adhesives, Vice Chairman of the F.S.B. Technical Committee on Adhesives, Secretary of the F.S.B. Technical Committee on Plastics, and member of the committees on Commercial Standards for Plywood and Polystyrene Plastic Wall Tile.

Frank W. Reinhart

MEET ME IN NEW YORK
JANUARY 18-20
7 TH SPE CONFERENCE

Albert Lightbody

William R. Bailey

Ralph K. Witt

Albert Lightbody is the head of the Chemistry Division of the Engineering Department at the big new Naval Ordnance Laboratory at White Oak, Maryland. One of his jobs is watching over the plastics developments at the laboratory, which boasts one of the finest plastics developmental laboratories in the government.

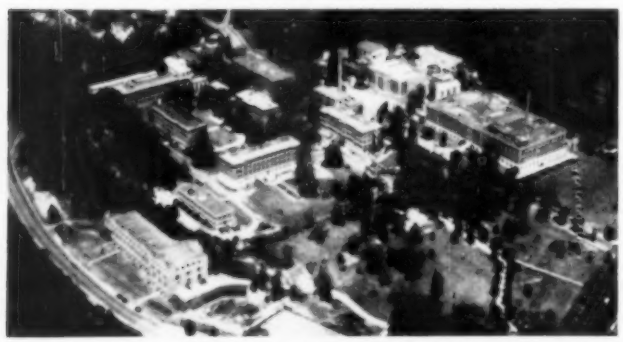
Dr. Lightbody obtained his Ph. D. in Chemistry at the University of Nebraska. After college training, he settled in Wilmington, Delaware, and was associated with E. I. du Pont de Nemours and Company. In 1943 he went on active duty in the Navy as Executive Officer at the Plastics Laboratory, Naval Ordnance Laboratory, Silver Spring, Maryland. After he returned to inactive duty, he associated with the Naval Ordance Laboratory as a civil servant, heading first the plastics group and then the Chemistry Division when consolidation took place.

William R. Bailey completed his undergraduate work at the University of Nevada, and graduate work at the University of California and Johns Hopkins University. He taught Plastic Engineering at George Washington University in Washington, D. C.

He was associated with Standard Oil Company of California and the Anaconda Copper Company. As a Lieutenant Commander during the war he was in charge of research and development of plastics for Navy combat materials. Later he was in charge of plastic research for the Bureau of Ordnance of the Navy Department in Washington. Recently Mr. Bailey has organized his own molding firm Allied Plastics Corporation of Washington.

Dr. Ralph K. Witt is associate professor of Chemical Engineering at Johns Hopkins University. His undergraduate work was completed at the University of Virginia and in Berlin, Germany. He received his PhD in Physical Chemistry from Johns Hopkins in 1931. After spending two years at the University of California on research, he joined the California Ink Company as Director of Research. He then joined Shell Oil Company for two years and returned to Johns Hopkins University in 1937. Dr. Witt is a member of the American Society of Testing Materials and has been associated with various research and development boards of the Armed Forces and the National Research Council. He has investigated and reported on the heat capacity of hydrocarbons and laminated plastics.

BUREAU OF STANDARDS



The National Bureau of Standards is located on sixty eight acres of wooded land in Washington's Northwest residential section, and is similar in atmosphere and environment to a large university. Its several hundred laboratories with a total staff of approximately 2800, are housed in 20 major and 50 minor buildings. Within them are to be found some of the worlds best facilities and equipment, ranging from a three story 1.5 million volt x-ray unit down to the smallest radio tube in the world. Scientific and technical activities at the Bureau include research and electronics, atomic and molecular physics, applied mathematics, building technology, electricity, optics, meteorology, heat and power chemistry, mechanics, organic and fibrous materials as rubber textiles, paper, leather, plastics, adhesives, and coatings; metallurgy, mineral products and radio propagation.

1950 DIRECTORS AND COMMITTEES

Directors: Gordon M. Kline — National Bureau of Standards; Frank H. Carman—Manufacturing Chemists' Assn., Inc.; Albert M. Stover—Naugatuck Chemical; Walter R. Sykes—Zenith Plastics Company.

Committee Chairmen: Professional Activities—Gordon M. Kline—National Bureau of Stds.; Membership—Clinton Rector—National Engineering Products; Credentials—John Lamb—National Bureau of Standards; Finance—John Alfers—Bureau of Ships; Program—Frank Reinhart—National Bureau of Standards; House—H. A. Perry, Jr.—Naval Ordnance Laboratory; Publicity—Frank Carman—Manufacturing Chemists' Assn., Inc.; Historical—E. B. Stratton, Jr.—Army Map Service; Educational—Ralph K. Witt—Johns Hopkins University; SPE Journal Reporter—Harry Williams, Jr.—National Bureau of Stds.; SPE Journal Advertising—Walter Sykes—Zenith Plastics Company.

Photographs of a few of the plastic concerns in the Baltimore-Washington area are shown on the next pages. Approximately 25 firms in this region are engaged in the manufacture and use of plastics. A list of these firms and the end products that they manufacture follow:

Advertising Plastics Co., Inc., Washington, D. C., Displays, gifts, specialties.

Allied Plastics Corp., Washington, D. C., Molded articles.

American Insulator Corp., New Freedom, Pa., Molding.

American Viscose Co., Front Royal Va., Viscose yarn.

Bingham Brothers Company, Baltimore, Md., Adhesives.

Cambridge Rubber Company, Taneytown, Md., Sheeting.

Crown Cork and Seal Co., Baltimore, Md., Closures.

Falge Engineering Co., Bethesda, Md., Pliable containers.

The Fessenden Process Co., Baltimore, Md., Special.

Hanover Rubber & Metal Co., Baltimore, Md., Molded goods.

Hedwin Corporation, Baltimore, Md., Plastic mats, embossed handbag material, shipping containers.

Holtite Manufacturing Co., Baltimore, Md., Shoe sole enforcements and toplifts.

William E. Hooper Co., Baltimore, Md., Dispersions.

Maryland Paper Products Co., Baltimore, Md., Straws.

Maryland Plastics Co., Baltimore, Md., Plastic sealed cards, photos, prints, etc.

Monarch Rubber Co., Baltimore, Md., Shoe soles.

National Engineering Prods., Washington, D. C., Special compounds for sealing or insulating purposes.

The National Plastic Products Company, Odenton, Md., Bristle, monofilament, laminates, spline, welt.

O'Sullivan Rubber Company, Winchester, Va., Film, sheeting, coated paper, tape, shoe findings.

Perry Record Company, Baltimore, Md., jazz records.

Plastics Assembled Prods. Co., Baltimore and Elkton, Md., Medical supplies.

S-K Laboratories, Baltimore, Md., Printing on film.

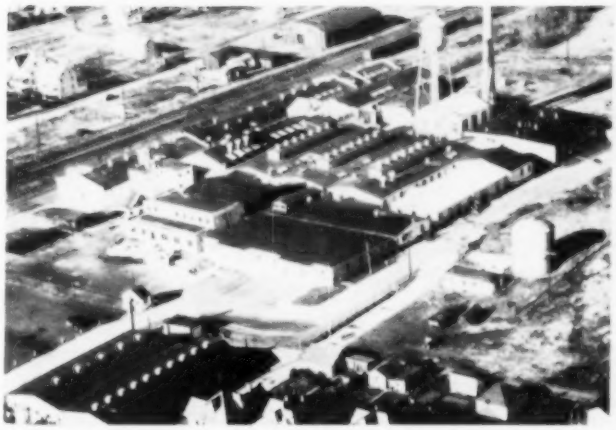
Standard Cap & Molding Co., Inc., Baltimore, Md., Molded caps and allied products.

Wama Plastics Company, Baltimore, Md., Displays and specialties.

Western Electric Company, Baltimore, Md., Insulated wire and cable.

ADVERTISING PLASTICS CO.

View shows dies, presses and cutting operations for the preparation of large and small display items. Finished products are shown to the right. Specializing in product replicas this firm is equipped to form articles up to eight feet.

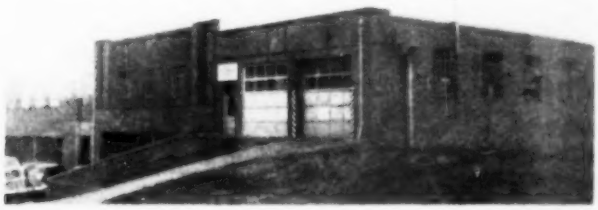


AMERICAN INSULATOR CORPORATION, NEW FREEDOM, PA.—This corporation is considered one of the largest custom molders in the United States, possessing hydraulic presses ranging in size from 5 to 2,000 tons. Founded in 1916, American Insulator are molders of all types of plastic materials by compression, transfer, injection, cold mold and low pressure methods. The plant covers an area of 125,000 sq. ft. and their facilities include a modern die shop which produces 90% of the tools and molds used. The low pressure molding department uses polyester resins and fiberglas as a filler and have one of the largest fiberglas preforms ever constructed. The normal employment is approximately 600.

HEDWIN CORPORATION, BALTIMORE, MD.—Hedwin fabricates many articles from plastic sheeting, such as embossed place mats ("Plastimat"), embossed sheeting for the manufacture of ladies' handbags, and flexible plastic liners for bulk shipping containers. Custom articles are formed also such as toy baby bath tubs. The firm employs about 75 people to operate electronic and resistance type heat sealing equipment, three dimensional embossing equipment, slitting and die cutting machines, silk screen printing, and forming equipment.

The Naval Ordnance Laboratory is the research and development establishment for ordnance for the Navy. Occupying about 900 acres in Montgomery County, Maryland, it employs about 2300 people, of which about 700 are professional scientists and engineers. Excellent facilities for all types of instrumentation and for developmental work make research and development work there a pleasure. Perhaps the best known facility is the large German windtunnel which permits studies of models with an air-flow velocity many times the speed of sound. Adequate shops support this large laboratory and the skills available there cover most of the arts and crafts.

WESTERN ELECTRIC COMPANY, POINT BREEZE WORKS, BALTIMORE, MARYLAND. Shown left to right: Cable Building, Wire Building and Power House. The Western Electric System is the manufacturing subsidiary of the American Telephone and Telegraph Company, and is one of the largest consumers of plastics in the world for such items as wire and cable covering telephones, communication parts and flooring for telephone booths.



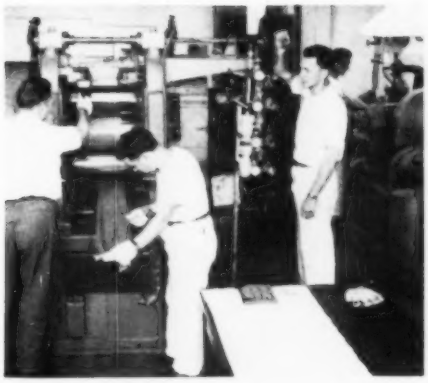
FALGE ENGINEERING COMPANY, BETHESDA, MD.—are manufacturers of pliable plastic containers from $\frac{3}{8}$" to $1\frac{1}{2}$" in diameter and from 1/16" to $\frac{3}{4}$" in height. Other sizes are made to order. These are suitable containers for tablets, pills, biological specimens, pharmaceuticals, radio parts, precious stones, small hardware parts.

Crown Cork and Seal Company, Baltimore, Maryland. This firm has two plants, as shown, in Baltimore and employs 1500 people. One plant manufactures machinery to package food and bottle products such as milk, beer and carbonated beverages. The second plant fabricates caps and closures for food containers and bottles for numerous uses. Synthetic rubber resin plastics are employed for rings and caps to seal food stuffs and for gaskets on beverage filling machines. Paper and other products are coated with polyethylene, vinyls and rubber hydrochloride as food liners.

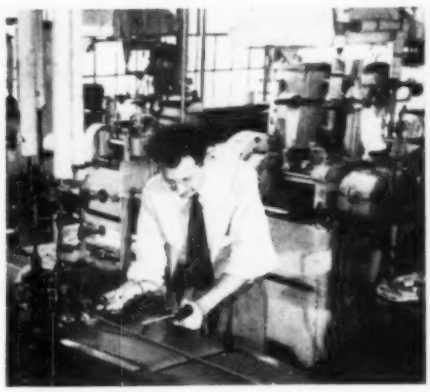
Clayton Rubensaal
Technical director of plastics and resins at Naugatuck

View of Naugatuck Chemical Laboratory in Baltimore. Heat stability apparatus in foreground gives accurate and reproducible results for resins and compounds. S. N. Green at desk and G. Cromer standing.

The constant temperature and humidity test room houses precision devices for determining tensile and tear strengths, low temperature performance and many other physical and electrical characteristics. Standing, R. Grant; sitting, T. Twigg.



Marvinol base unsupported film comes off 4 roll calender. Left to right: W. Clark, J. Lombardi, D. Whippo. Naugatuck Chemical's Marvinol Laboratory is being moved to Naugatuck, Connecticut.



Other customer service facilities include extruder in foreground, mixing mills at rear. H. J. Wiesner is shown checking the stock temperature of compound from the extruder.

H. M. Parsekian
Sales Manager at Naugatuck

Baltimore-Wahington Has Varied Memberships and Well-Attended Meetings

Most of the present members come from non-industrial Washington but a large group also comes from Baltimore. Many Baltimore members will be lost to the Section when Naugatuck Chemical moves their Marvinol Laboratory from Baltimore to Naugatuck, Connecticut.

Meetings are held in both Washington and Baltimore in an attempt to keep the membership about equal in both cities. Meetings are usually held on the second Tuesday of each month at Johns Hopkins University in Baltimore, or in the Washington area at the National Bureau of Standards, or the Naval Ordnance Laboratory at White Oak, Silver Spring, Maryland. To stimulate active interest in our section, topics for meetings have been carefully selected in accordance with the wishes of our members. The meetings have been well attended, with many visitors at times to hear the open discussions which follow the scheduled talks and which are participated in by practically the entire group.

A large part of the membership of the Baltimore-Washington Section is made up of civil servants of various branches of the government such as the National Bureau of Standards, Naval Ordnance Laboratory, Naval Research Laboratory, Bureau of Aeronautics, Departments of the Army such as the Office of the Chief of Engineers, Office of the Chief of Ordnance, Quartermaster General, Army Map Service, Army Medical Center, War Department Research and Development Laboratories, Bureau of Ships, Bureau of Ordnance, National Research Council and various branches under the Department of Commerce.

In times of national emergencies, members of our Section, acting as a unit, can give substantial help to our government and the plastic industry. Many of our members have been discussing and suggesting methods which would enable our group to become an effective industrial tool. Although this problem has not been resolved to date, it has been decided that we would solicit proposals from members in other sections. If you have any questions on government projects not considered secret, we will attempt to assist you.

The Baltimore-Washington Section extends an invitation to hold a national conference in Washington at any time suitable to our national officers.

To familiarize our wives and friends with the Plastics Industry, ladies night was held last May in the Park Plaza Hotel in Baltimore. In addition to dinner, dancing, and door prizes, a film on cellulosic plastics was shown by courtesy of the Hercules Powder Company. Television receivers were provided by the Leon Levi Company of Baltimore to receive a television show in plastics given by Dr. R. K. Witt and previously arranged for the same date. Dr. Witt's talk, scheduled through the Johns Hopkins University Science Review, was broadcast over Baltimore Station WAAM and relayed over television stations in Washington. Samples of many plastic end products were obtained from firms throughout the country and displayed during this show.

Left to right, D. Nitzberg and guest Mr. and Mrs. D. Edwards, Mr. and Mrs. A. Stover examine door prizes given through the courtesy of: Electric Hose Rubber Co., Wilmington, Del.; Hungerford Plastics Corp. Murray Hill, N.J.; Industrial Synthetics, Garwood, N.J.; Sponge Rubber Products, Shelton, Conn.; U. S. Equipment Corp., Victor, N.Y.; U. S. Rubber Co., Passiac, N.H.; Television receivers were provided by Leon Levi Company of Baltimore.

Ladies' Night in the Park Plaza Hotel in Baltimore featured dinner, film on cellulose plastics by Hercules Powder Company, dancing and many door prizes. Above— watching Dr. R. K. Witt on television show on plastics given the same night and broadcast from WAAM—left to right, Mr. and Mrs. W. DeC. Crater, Mrs. R. K. Witt, Mr. and Mrs. A. M. Stover.

MIAMI MEETS WITH MECHANICAL GROUP

By JOHN L. RUSSELL

"Plastics as an Engineering Material" was the subject of talks by two Miami Valley Section Plastics Engineers at a joint meeting of the American Society of Mechanical Engineers (A.S.M.E.) and the Society of Plastics Engineers, Inc., (S.P.E.) on Wednesday, October 25, at the Engineers Club, Dayton. Victor Reiling, Kurz-Kasch, Inc., discussed "Thermosetting Materials" while Byron Nelson, National Cash Register Co., handled the "Thermoplastics."

Both Reiling and Nelson are considered authorities in their respective fields of plastics and their talks created much interest among engineers and others interested in end uses of plastics. A question and answer period followed the formal talks.

On November 9, SPE members will meet at King's Restaurant, Reading and Section Roads, Reading, O., for a dinner, followed by a symposium on 1-step resins. Participating in this affair are Tom Scott and John Brierley, of Dayton, and Merle Nelson and Carl Weber, of Cincinnati. Considerable pioneering work on the use of 1-step phenolics in molding has been done in this area, particularly in Cincinnati. A lively discussion period by the members is sure to follow the talks.

Candidates up for election to the Board of Directors for three year terms are Ralph Backscheider, Recto Molded Products, Inc., Carl Weber, Crosley Div., Avco Mfg. Corp., Joseph Overwein, Inland Mfg. Div., G.M.C., William Robinson, Buckeye Molding Co., Harry Kniess, National Cash Register Co., and Otto Fiedler, F & F Mold & Die Works.

The annual Christmas party for members and their ladies will be held on December 9 at the Miami Valley Golf Club, Dayton. There will be bingo, entertainment and a buffet lunch. Heading the Committees for this event are Jack Braden, John Brierley, Walter Oelman, and Marty Kasch, all of whom were appointed by Section President Robert Gerdes.

TOLEDO

By E. H. JOHNSON

With material shortages at hand the conservation of polystyrene is of utmost interest to all plastic molders. Surprising as it may seem, dry coloring polystyrene crystal granules makes large savings of material possible through elimination of waste.

The subject was thoroughly covered in a talk by Mr. S. R. Melvin, Technical Service Department, Monsanto Chemical Company, Springfield, Massachusetts, before the Toledo Section, Society of Plastic Engineers. The meeting was held on Thursday night, October 26, 1950.

CLEVELAND-AKRON WORKS WITH 2704th RESEARCH & DEVELOPMENT UNIT

Kennedy on Informative Labeling is October Speaker

By R. E. LALLY

For some time it has been the privilege and pleasure of the Cleveland-Akron Section to welcome the participation of members of the 2704th Organized Reserve Research and Development Training Unit in various activities of the Section.

The close cooperation of the Cleveland-Akron Section of SPE and the 2704th Unit is the first case of the SPE working with Units of this type, and the recent emergency created by the Korean situation has pointed up the great importance of such cooperation.

The 2704th Organized Reserve Research and Development Training Unit, with headquarters in Akron, Ohio, is headed by Lt. Colonel Foster J. Young, who is a member of the Cleveland-Akron Section, and is made up of approximately thirty Reserve Officers of The Department of the Army. These members are Reserve Officers whose civilian occupations include some form of research and development, and consist of personnel from Goodyear Tire and Rubber Company, Firestone Tire and Rubber Company, Goodrich Tire and Rubber Company, General Tire and Rubber Company, other industrial companies and Akron University.

The purpose of the organization is to maintain the interest of scientifically trained Reserve Officers to the extent that they will remain active and be available to serve our country in time of emergency in the capacity for which each man is best qualified and with the least possible delay.

The majority of the Reserve Officers in this Unit are working on projects assigned by Service Organizations such as Ordnance, Quartermaster, Signal Corps, Chemical Corps, etc.

Due to the increasingly important position of plastics in the national economy and safety in recent years, still closer cooperation is desirable between members of the SPE and the various Organized Reserve Research and Development Training Units.

The Navy and Air Force, as well as the Army, maintain such research and development units throughout the country and it is hoped that other SPE Sections may wish to contact those Units, in their respective areas, to lend the background and know-how of the plastic industry to the furtherance of their operations.

The October dinner-meeting of the Cleveland-Akron Section, at Akron's Garden Grille was enjoyed by forty members and guests on Monday evening, October 30th.

Program Chairman, George Field introduced the speaker of the evening, Mr. E. D. Kennedy who is Sales Promotion Manager, Plastics Division, Monsanto Chemical Company, Springfield, Massachusetts.

The subject of "Informative Labeling" was covered in an interesting manner by Mr. Kennedy, who symbolized the Plastic Industry as a modern 1950 automobile being driven by a cave man, the automobile representing the advanced technology of the Plastic Industry, the cave man representing the public relations existing in the industry. Thus, with the "car" in perfect operating condition, it is time to give some attention to the improvement of the "driver."

The new Handbook on Informative Labeling, published by the Informative Labeling Committee of The Society of The Plastics Industry, Inc., was distributed to those present, and its contents were discussed by Mr. Kennedy. Copies of the Handbook may be obtained by writing the SPI Committee on Informative Labeling, 295 Madison Avenue, New York 17, New York.

Dr. Warren Stubblebine, Research Director, Chemicals and Plastics Section, Research and Development Branch, Office of the Quartermaster General will discuss plastics uses in the Armed Forces, at the November 27th meeting.

Announcement was made of the December 11th date for the Section's Christmas Party to be held at Aurora Inn, Aurora, Ohio.

The evening was completed with further music by the group, as President Ward Van Orman offered selections on the harmonica, accompanied by Wayne Anderson at the piano.

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POLYESTER RESIN USES AND PROPERTIES ARE OUTLINED AT NEW YORK

By A. M. MERRILL

Approximately 65 members and guests of the New York Section attended a regular meeting on October 18 at the Hotel Shelburne. The technical session, following a cocktail hour and dinner, featured a talk on "Polyester Resins" by J. D. Robinson, American Cyanamid Co.

Dr. Robinson began his talk with a review of the important wartime applications of low pressure polyester resins, noting that the materials went directly from the laboratory to wartime use without the normal intermediate process of development. With the end of the war, little was known of the peacetime applications of these resins and a program of development was undertaken. Polyester resins are thermosetting materials which have a wide range of properties extending from highly rigid, brittle types to flexible materials. All of these resins react without the need for removing solvent; are easily handled because they are fluid and supplied in a wide range of viscosities; and can be furnished to meet specific needs such as fire resistance.

Polyester resins cure rapidly at low pressure and with exothermic reactions. Problems involved in their use include shrinkage during cure; the need for control of the curing reaction to prevent damage to the finished part; their unsuitability for transparent parts; and the need for special precautions to insure good surface finish in certain applications. Shrinkage during cure can often be controlled by proper application of pressure and good mold and part design. Work to date has shown that the curing reaction can be controlled by choice of catalyst and the use of inert mineral fillers.

The major use for polyester resins at present is in mat molding, using Fiberglas reinforcement. Other applications include paper base laminates; industrial castings, particularly for electric uses; and the surfacing of plywood, masonite, and other materials. Dr. Robinson displayed many samples to illustrate typical applications, and discussed the methods by which they were made.

In the business session preceding the talk, reports were heard from secretary-treasurer George Baron, Ideal Plastics Corp., and program chairman W. A. Ward, American Cyanamid Co. The forthcoming Christmas party was discussed, and it was voted to make the party a stag affair. President Sam Silberkraus, Riverdale Laboratory, appointed the following nominating committee to select a slate of candidates to fill the three vacancies on the board of directors next year: Saul Blitz, Noma Electric Corp.; A. L. GeWertz, manufacturers representative; R. H. Skidmore, Celanese Corp. of America; R. F. Stott, Stott Tool & Machine Co.; and A. M. Merrill, "India Rubber World."

The meeting concluded with a showing of the Ford Motor Car Co. color-sound film, "The Human Bridge," and a drawing for a door prize contributed by American Cyanamid Co. Table favors were distributed through the courtesy of Novoplast Mfg. Co.

The Section's annual Christmas party will be held on December 20 at the Hotel Shelburne. On January 10, the Section will be the guests of the Newark Section at a joint meeting at the Military Park Hotel, Newark.

PHILLY HEARS G-MEN

By D. I. YARNALL

The Philadelphia Section will be addressed by the following two government representatives whose timely and pointed discussions will deal with government specifications for plastic parts:

Mr. Dana D. Stratton, supervisor of the Standardization Unit, Naval Aircraft Factory, will speak on the subject of "Military Specifications as Applicable to Aircraft." The Standardization Unit prepares specifications describing equipment and materials for use in Bureau of Aeronautics and Air Force airplanes. Special emphasis will be placed on plastics specifications and the manner of establishing their requirements. It is hoped that this discussion will provide much useful information concerning the interpretation and usage of Government specifications.

Mr. Charles N. Gardner, Chemical Engineer, Chemicals and Plastics Section, Res. and Dev. Branch, Quartermaster Corps, U. S. Army, will discuss specification items of major importance to the plastics industry with specific reference to the recent work on plastic tableware and reinforced plastics.

Penn Notes

By PAUL ROCHE

Mr. A. J. Simons has recently become connected with Shaw Engineering Co. of Franklin, Penna. "Si" is well known in local plastics circles, having had broad experience in molding and tool building circles in the area.

Word has reached us that J. A. Loranger resigned recently from Sylvania Electric Products Corp. and plunged into the molding business at Warren, Penn. We will report in greater detail when we have a chance to learn more regarding the nature of the business, the name of the company, and his associates; meantime we all wish him well. "Al" is a past secretary and program chairman of the section and was well respected for capable administration of his supervisory engineering work at Sylvania.

We are interested to report that at least two local companies are currently filling defense orders for molded plastics. Perry Plastics and Applied Plastics, both of Erie, are working on contracts for Picatinny Arsenal. NOSCO Plastics of Erie recently completed an injection molding contract for The Bureau of Ordnance, U. S. Navy.

Paul Roche, NOSCO Plastics, is in a dangerous state these days. Following the birth of his daughter in October, he won't refrain from throwing out his chest long enough to inhale. The two little Roche boys and mama are happy about the whole thing too.

AIR FORCE AT TEXAS

By ALFRED FUKAL

Major William J. Weaver, USAF Public Information Officer Air Materiel Command, Fort Worth, Texas, addressed the South Texas Chapter of the Society of Plastics Engineers at a dinner meeting October 18 at the new Guy Francis Farnham House, Houston, Texas.

Major Weaver, who was invited by the local chapter to give this informative talk, explained the needs of the Air Force and other branches of the armed services, and methods by which defense orders may be obtained.

The meeting, which was attended by virtually the entire plastics profession in this area, proved to be vitally interesting and constitutes the initial effort by the local plastics industry to meet the present emergency.

Presiding were Charles E. Shepherd, Industrial Plastics Manufacturing Company, Houston, chapter president; and Alfred F. Fukal, independent industrial designer, program chairman.

SOUTH CALIFORNIA

The Southern California Section met on October 12 at the Officers Club in Los Angeles to hear a discussion of "Wax Models for Tooling." Mr. E. F. Montgomery described the preparation and the utilization of wax models. Mr. Pat Howerton of Duncan & Rhone discussed the lost wax method of producing metal models from wax molds and Mr. Paul Silverstone of Super Matrix Co. discussed the electroplating process of making molds from wax models. A display was arranged for the meeting and ample time was allowed for discussion of the interesting models and processes.

RHODE ISLAND

The Rhode Island and Southeastern Massachusetts Section of the SPE met on October 11 at Providence, R. I. to hear Mr. Milton Greenhalgh discuss "Processing of the Vinyls for Estrusion and Injection Molding."

NEW ORLEANS MEETS WITH CHEMISTS

By LEON GODCHAUX II

New Orleans SPE met jointly with the American Institute of Chemical Engineers, on October 19, at the St. Charles Hotel.

After both Societies had conducted their respective business, the speaker of the evening was introduced.

Mr. D. V. Probasco, Director of Lantuck Dept., Wellington Sears Co. Inc., New York, addressed the joint meeting on "The Development of Lantuck." He described this resin-bonded non-woven fabric and covered its history from inception through research, pilot-plant and production stages. He also discussed the future of non-woven fabrics, and particularly of Lantuck.

A lively discussion followed the meeting, after which the meeting was turned over again to Acting Chairman Pollard of A.I.Ch.E., who called for a rising vote of thanks to the speaker.

The joint meeting adjourned at approximately 9:45 p.m., after which refreshments were served.

Ralph F. Chambers of New Orleans, La., has accepted a position as sales representative with Pan American Plastics, Inc., Dallas, Texas, and is moving to that city. On August 15th, he resigned his position as President and General Manager, and Chairman of the Board of Directors, of Plastics Productions, Inc., New Orleans. Mr. Chambers, formerly a Naval Architect and Marine Engineer with the Navy Department, entered the plastics field when he organized Plastics Productions, Inc. in March 1947. He is well known throughout the South.

Klippings from Kozy

By WALTER KOZY

Chrysler Corporation

The appointment of Fred Seuffert as chief chemist in charge of the laboratory at Fabricon Products, Inc., River Rouge, Michigan, was recently announced. Mr. Seuffert has an extensive experience in the resins field, having spent ten years with the Ditzler Paint Company doing research work on automotive and industrial lacquers and coatings. Most recently he was employed by Lyon, Inc., where he was engaged in development work. Best of luck to you, Fred!

Russell Haeger, of the Detroit sales office of the Dow Chemical Co., was the lucky winner of the Kelvinator refrigerator that was raffled off by the Detroit section of the SPE recently. Object of the raffle was to raise a benefit fund for Dick Walsh, sales representative for the Monsanto Chemical Co., and the victim of one of the worst streaks of hard luck we've heard of in a long time. A net total of $800 was made and turned over to him by the Sick and Visitation Committee.

Congratulations are in order for Harry Kline, manager and technical director of the Phenolic Plastics Division of Reichhold Chemicals, Inc., in Detroit. Doc Kline (who was largely responsible for the tremendous job that was done in compiling a reference index in the laminating field for the SPE Professional Activities Committee) was appointed a divisional vice-president of Reichhold Chemicals at a recent meeting of the board of directors of the company.

On October 25, members of the Detroit section of the SPE met with engineers from the Society of Body Engineers and the Society of Refrigeration Engineers in the Rackham Memorial Auditorium to hear a panel discussion on applications of plastics in the automotive and refrigeration fields. The discussion was organized around a skit which purported to show what went on in the conference of the Jones Molding Company when the sales engineer brought in a job. Members of the panel were: Robert Dailey (sales manager for Wolverine Plastics) who acted the part of the sales engineer; Harry Haaxma (general manager for Wolverine Plastics) playing the part of the mold room superintendent; Dr. E. Storfer (plastics engineer for Chrysler Corp.) materials engineer; Al Stomp (general manager of Una-Craft Engineering) mold designer and builder; J. Hitchcock (Sundberg and Ferar, Design engineer) stylist and part designer; D. Briggs (Wolverine Plastics) accountant; and Jack Totten of the Ford Motor Co., moderator.

One of the jobs brought in by the sales engineer was a dash board panel for one of the automotive companies. Starting from there the various experts on the panel each contributed opinions and information which gradually built-up a complete picture on how the materials are selected, how the tooling is engineered, how the production is handled, and how the piece price is arrived at for this application.

Similarly, the panel next took on a breaker strip for a refrigerator and proceeded to engineer the job with very enlightening results.

A question and answer period followed the panel discussion, in which the audience participated vigorously.

USE OF PREMIUMS TO INCREASE SALES AND TALK ON ADHESIVES FEATURED AT NEWARK

By JOHN GROESBECK

The October dinner meeting of the Society of Plastics Engineers was held at the Military Park Hotel, Newark, N. J., on October 11th. About seventy-five members and guests were present. Two door prizes were donated by Ed Sytes of Monsanto Chemical Co.

A short business meeting was marked by President Akin's report on the recent S.P.I. meeting with material suppliers and molders to discuss current material shortages. The stockpiling of various raw materials by the government was given as the reason for these shortages. It is not believed that this condition will be improved in the near future.

The first speaker of the evening was Mr. F. H. Waggoner, Executive Secretary of the Premium Advertising Association of America, whose topic was 'How to use Premiums to Increase Sales'. His talk, which was accompanied by a sound film, was well received.

The second speaker was Mr. Ray Platow of the Bell Telephone Laboratories, Murray Hill, N. J., who spoke on 'Adhesives—Some Theoretical and Engineering Conceptions'. Mr. Platow explained and illustrated some of the better methods for assembling metals and plastics by the use of various types of adhesives. Of special interest was an adhesive supplied in the form of a thin dry film similar to cellophane, and utilized by the application of heat and normal clamping pressures.

TORONTO HEARS TALK ON TEMPERATURE CONTROL AND MOLD DESIGN

By J. N. KEMPF

The Toronto Section's first meeting of the Fall Season was held at the Ryerson Institute of Technology, 50 Gould Street, Toronto, Ontario, the evening of Monday, October 23rd, 1950, at 8:30 p.m.

President McEwen introduced Mr. H. A. Meyrick, the guest speaker of the evening. Mr. Meyrick is President of the Industrial Manufacturing Corporation, Indianapolis, Ind. Mr. Meyrick has specialized in industrial problems involving the design and control of processes in which heat is a factor.

Mr. Meyrick's subject was entitled "Temperature Control and Mold Design."

Using a graphical form of illustration he described the job of mold temperature control and emphasized its importance with regard to maintaining close controls over the following three variable factors: (a) uniformity of temperature over the mold area (b) uniformity of temperatures shot after shot (c) addition or removal of heat from the mold area at the optimum rate for efficient molding cycles.

Circulation of water is the best means of controlling mold temperatures not only because it is a good transmitter of heat but is available in large quantities and is economical. However, the temperature of the water coming out of the mold should be essentially the same as the temperature going in. This requires high velocity circulation of controlled temperature water.

When temperature variations occur in multiple cavity molds, the molding cycle necessarily has to be set to fit the worst cavity usually resulting in lost time, lag and not the most efficient molding cycle. Mr. Meyrick gave examples which illustrated that variations in mold cavity temperatures of even 2 to 3 degrees could cause scrap. A 5 degree variation was shown to be excessive and could cost money in the quality of the casting, the cycle, or both.

The next part of the discussion centered around the design of water lines into the mold construction. It was illustrated how poor design results in improper cooling, non-uniformity or cavity temperatures, lag and lost time in the molding cycle. In the same mold an improved design and control resulted in a 16% production increase. When possible, the water cooling channels should be incorporated in the cavity mold metal and not in the back-plate or other points where resistance to heat transmission can be set up. In short it is necessary to design the molds so this process can work effectively to produce optimum results.

Mr. Meyrick's closing discussion concerned surface pyrometers and the means of obtaining actual facts concerning cavity temperatures. A continuous record of factual data can assist in the design of better molds and temperature controls to the benefit of each molder in his own establishment. The performance of an existing mold can often be improved when a factual record is kept, over a period of time, employing a surface pyrometer to obtain information and cavity temperatures. If the individual molder endeavors to keep such a record, it will point the way to better mold construction resulting in more efficient molding cycles and high quality castings.

A lengthy and stimulating question period followed Mr. Meyrick's lecture, at the conclusion of which President McEwen thanked the speaker on behalf of the Toronto Section for his excellent talk.

NEW PROCESS FOR SAND MOLDS IS DESCRIBED AS IMPORTANT TOOL AT BUFFALO

By EUGENE C. ROECK

On October 20, 1950, the Buffalo Section played host to the local Western New York Chapter of the American Foundrymen's Society to hear a talk by Mr. Frank Less of Durez Plastics & Chemicals, Inc., on the new shell mold process for the foundry trade. Approximately 75 members of the two groups heard Mr. Less give a very informative talk on this new process.

Some advantages of this new foundry tool are closer tolerances for precision work, and cleaner castings requiring little or no finishing. The equipment needed for this process is as follows:

Suitable metal pattern with a means for removing the cured shell.
Lubricant for the metal pattern.
A sand and resin mixture.
Dump box.
Oven.
Box to hold molds for pouring.

(1) The pattern is placed in an oven and allowed to heat to 375 - 450° F.

(2) A sand and phenolic resin mixture is made and placed in a dump box so designed that it may be inverted 180°.

(3) The pattern is removed from the oven, lubricated, and clamped on the dump box.

(4) The dump box is inverted for several seconds and then returned to the starting position.

(5) The pattern is removed from the dump box and placed in the oven for 1-2 minutes to cure the material adhering to the pattern.

(6) The pattern is removed from the oven, the shell mold is removed, and the cycle is then repeated.

(7) The shell molds are then clamped together and surrounded by metal shot for casting.

Midwest Hears Formo Plans Future Program

By D. H. CHAMBERS

The Upper Midwest Section heard Dr. M. W. Formo speak on "Industrial Application of Drying Oils" on October 9. Some of the points that were covered were the processing of these oils, their volume consumption and increasing demand in many fields—one important one being the plastics industry. Many are not aware of the part drying oils are playing in plastics today. More and more dependence is put on these oils for both coating and molding materials. Recent developments in the paint industry were also discussed. In addition, the latest Alaskan Hunting movie was shown by Dr. Smith.

Don Norton of 3M, the section Program Chairman, has been recalled to active duty. He is a Lieutenant Senior Grade Meteorologist in the Navy and is on his way to the Pacific.

The program schedule for the rest of the year is as follows:

November 13—"Plastics and Coating Techniques" by D. S. Plumb, Monsanto Chemical Co. Forum on education in plastics — Fred Wehmer, National SPE.

December 11—"Plastics in the Tape Industry" by James Corbin, Minnesota Mining & Mfg. Co.

January 8—Subject to be one of these three: Thermoplastic molding; Teflon or Kel-F; Terylene resins and films (duPont development improvement on Nylon).

February 12—"Polyethelene Molding and Coatings" to be arranged by J. H. Kugler.

March 12—"Industrial Adhesives" by Dr. W. J. Clayton, Minnesota Mining & Mfg. Co., Detroit.

April 9—"Product Design" to be arranged by J. Formo and S. K. Moxness.

May 14—Plant trip—to be arranged.

7 TH ANNUAL TECHNICAL CONFERENCE
January 18-19-20

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JOURNAL

Official Publication of The Society of Plastics Engineers, Inc. 409 Security Bank Building, Athens, Ohio.

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Industry Notes

PVC PRICE RISE

Price increases for polyvinyl chloride ranging from 2 to 4 cents per pound were announced by Naugatuck Chemical Division, United States Rubber Company, Naugatuck, Conn.

The new prices, however, will include freight charges while the old prices were quoted F.O.B. Painesville, Ohio, the company said.

The advances include both the Marvinol VR-10 and Marvinol VR-20 resins and become effective immediately.

The minimum price for both resins is now 36 cents per lb. in lots of 20,000 pounds or more. The previous price was 33 cents per lb. in lots of 30,000 pounds or more.

WITCO REPORT READY

Witco Chemical Company has issued the following new series of Technical Service Reports:

Report S-3 "Witco Stabilizers and Lubricants for Plastics" which is a reference sheet designed to acquaint formulators with general information and the important properties of the Witco stabilizers and lubricants for polyvinyl chloride plastics.

Report M-11 "Witco Stearates for Protective Coatings" gives information on complete line of metallic stearates for the protective coatings industries . . . aluminum, calcium, and zinc. The report allows the formulator to find the metallic group best suited for his purpose.

Report P-13 "Witco 24% Lead Naphthenate" covers the properties of the Witco 24% lead naphthenate which are especially important to the paint industry.

Write to Witco Chemical Company, 295 Madison Avenue, New York 17, N.Y., for copies of these reports.

BIG PRESS INSTALLED

The efficient high-pressure laminating press, shown on last month's SPE Journal cover, has recently been installed by the National Plastic Products Company at Odenton, Maryland for the production of 4' x 8' Nevamar decorative high-pressure laminates. The heating-cooling and automatic temperature control system was installed by The American Hydrotherm Corporation of New York. The heating and cooling cycle follows a predetermined curve correlating time and applied temperature.

A constant pressure Hydrotherm accumulator is utilized, which permits reduction in peak load on the boiler to one-third. This is a unique design successfully applied for the first time in this country.

HANDLING EXPOSITION

The fourth National Materials Handling Exposition is scheduled for Chicago April 30 to May 4 inclusive at the International Amphitheatre. Several hundred companies will exhibit thousands of models to provide the most extensive display of cost-reducing handling machinery ever assembled. In conjunction with the exposition which is being sponsored by the Material Handling Institute, the American Material Handling Society will conduct a conference for consideration of general handling problems including building of materials handling systems, surveying materials handling problems, relating handling to other departments, determining handling costs, and presenting a materials handling program to top management. An exhibitors list and tentative program are available upon request from Banner & Greif, 256 W. 57th St., New York 19, N.Y.

NEW CYLINDER PURGE

Announcement has just been made by Injection Molders Supply Co., of a new material designed to assist injection molders in purging heat cylinders. The Purger, mixed with scrap or new material, scours the internal parts of the heater, taking out clinging portions to cut scrap as much as 100% when changing materials. Injection Molders Supply Co., Penton Building, Cleveland 13, Ohio are national distributors of the Purger. The company has also just prepared a new bulletin on Meridian constant temperature circulator and IMS injection machine nozzles that will be sent on request.

CYCLON DATA

The Munray Products, Inc., Division of Poly-cyclo Products Co. 12500 Crossburn Avenue, Cleveland 11, Ohio has recently prepared a bulletin on CYCLON which contain valuable information and technical data on many corrosion resistant materials for the processing industries.

PABCO NEW NAME

The Paraffine Companies, Inc., announce that as of November 1, 1950 their company will be know as PABCO PRODUCTS, INC. The trade name Pabco has been used for almost 50 years to identify the increasingly diversified products of the company. The company has decided to enable their customers to readily identify the name of the company with the many products and activities. There have been no change in management or policies. The address is still: Head Office, 475 Brannon Street, San Francisco 19, Calif., and Factory Office, Emeryville 8, Calif.

LETS FIGURE

The Seminar on Industrial Computation held at the International Business Machines Corp. laboratories in Endicott, N.Y. dealt with the use of mass-produced electronic calculating machines. An increasing number of industrial design problems, which heretofore were worked out by construction of experimental models, can now be solved by the engineer. Two research teams described pioneer work along these lines and demonstrated use of the machines.

ELASTIC PLASTIC

The United States Rubber Company has recently announced the development of a product called elastic Naugahyde for use in the upholstering of cars, chairs sofas etc. It will stretch in every direction, remain soft and pliable, does not bag or wrinkle, needs no wetting or special tools for handling, is resistant to scuffing and tearing and can be washed with soap and water.

HAMMER FINISH

A baked hammer finish formulation worked out in the laboratories of Rohm & Haas Co. has been recommended to paint manufacturers by the Resinous Products Division. The formulation depends upon the use of Uformite F-233 and Amberlac 80X. These coating resins give close duplication of patter when panels are sprayed and baked in either a horizontal or vertical position. The combination avoids the sagging and after-flow often encountered with the other vehicles.

CANADIAN KELLOGG

Canadian Kellogg Ltd., has started operations in a new pipe fabricating shop in Edmonton, Alberta, it was announced today by the parent company, The M. W. Kellogg Company, engineers and fabricators of New York and Jersey City. According to Kellogg, the shop was opened to service the rapidly expanding requirements for power and process piping in western Canada.

STOKES GAINS

The F. J. Stokes Company, Philadelphia, Pa., well known in the manufacture of industrial machinery, has launched a $700,000 expansion program, adding one third in space to the present plant, Francis Dougherty, president, announced. The new factory addition will be consistent in style with the present modern red brick building trimmed with Indiana limestone. Completion is scheduled for early 1951.

VINYL UPHOLSTERY

United States Rubber Company has published an attractive 24-page illustrated booklet on vinyl plastic coated fabrics, designed to answer questions on the uses and advantages of this type upholstery material.

Anyone who has used or plans to use plastic upholstery will be interested in the new booklet, "The Story of U. S. Naugahyde" which can be obtained free of charge by writing to the coated fabrics department United States Rubber Company plant, Mishawaka, Ind.

VOPCOLENE

Purchase of the plant and facilities of W. C. Hardesty Co., Inc., at Los Angeles, was announced this month by C. A. Roberts, president of Vegetable Oil Products Co., Inc., Wilmington. Roberts said the Los Angeles plant will operate as the VOPCOLENE DIVISION of Vegetable Oil Products Co., Inc., 5561 E. 61st St., Los Angeles, Calif.

Manager in charge of the plant will be W. J. O'Connell, who headed the operation under the Hardesty administration. No major changes in production are anticipated, according to Roberts. Fatty acids and industrial oils produced in the plant will be marketed under the trade name of VOPCOLENE.

HERCULES AWARD

Direct mail advertising used by Hercules Powder Company to promote the sale of its cellulosic plastic flakes and molding powders was judged "Best in the Plastics Industry" for the second successive year, it was announced by the Direct Mail Advertising Association. Best of Industry Awards for 1950 were made October 4 at the Special Awards Breakfast at the Hotel Roosevelt, New York City, which opened the DMAA's 33rd Annual Conference and Exposition. Philip A. Bels, who prepared the winning campaign, accepted the Hercules award in behalf of Theodore Marvin, director of advertising.

NEW LAMINATE

A new paper-base phenolic laminate, offering an unusual combination of properties for use in high-frequency insulating applications has just been announced by The Richardson Company, makers of INSUROK laminated and molded plastics products.

Designated INSUROK Grade T-812, the new grade retains all the properties of INSUROK T-725, which has found wide recognition throughout the radio and television industries for its high-frequency insulating capabilities. These properties include outstanding electrical characteristics, high physical strength, and excellent punchability. However, the new grade has lower moisture absorption than T-725, and much higher insulation resistance—1,000,000 megohms after humidity conditioning (1/16" sheet)—an advantage lacking in other laminates.

INSUROK, Grade T-812 is available in a complete range of sheet sizes and thicknesses. Complete information is available from The Richardson Company, 2793 Lake Street, Melrose Park, Illinois.

JOURNAL

Volume 6, Number 10, Dec. 1950

Published monthly except July and August by the

SOCIETY OF PLASTICS ENGINEERS, INC.
409 SECURITY BANK BLDG.
ATHENS, OHIO

Dr. Jesse H. Day, *Editor*

Editorial Advisory Board: MARIO PETRETTI, J. H. DUBOIS, WAYNE PRIBBLE, CARL J. FROSCH

Advertising Representatives: Ortgies & Dillon, 155 East 44th St., New York 17, N. Y.

30 cents a copy **$3.00 a year**

Entered as second-class matter at the Post Office at Athens, Ohio.

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The Society of Plastics Engineers Journal is not responsible for the views expressed by individual contributors. All material submitted must be received not later than the fifth of the month for publication in that month. Communications should be addressed to Dr. Jesse H. Day, Society of Plastics Engineers Journal, Athens, Ohio.

IN SHOP PRACTICE

In the SPE JOURNAL, Volume 6, Number 8, for October, 1950, in the "Q's and A's" column on page 4 in the answer to problem 4 concerning the use of polyethylene as a container for menthol, it is stated that if "the polyethylene is responsible for the menthol loss, there is little likelihood that another plastic would be much better." Our experience does not agree with this statement. We have found saran to be many times more impermeable to losses from compositions containing menthol and essential oils in general. It is possible that if saran can be applied to this manufacturer's application that he will find it much superior to polyethylene.

Orr Writes From Germany

Mrs. Bess Day, Executive Secretary,
Society of Plastics Engineers,
Athens, Ohio.

Dear Bess:

Following your suggestion I attended the meeting of the German Plastics Industry and Engineers at Munich, Germany on October 16th and 17th. Here is a report which should be entered in the files.

Five separate groups entered into this meeting as follows:

The Society of German Engineers (KDI)
The Plastics Industry of Germany (GKV)
The German Chemical Society (Gd-Ch)
The Union of Plastics Workers (AKE)
The Testing Society (FWK)

There is no group of Plastics Engineers in themselves, but they belong to the other groups, especially the VDI and are a subsidiary group in VDI. There is apparently complete harmony in the various groups.

The meetings were held in the Physics Lecture Hall of the Technical High School. Many of the buildings in this school suffered severe bomb damage. The type of room was most excellent. When the meeting was called to order at 9 A.M. between 350 and 400 were in attendance which speaks for the interest and German discipline. The meetings were held on Tuesday, Wednesday and Thursday with Monday and Friday given over to Committee Work. The Banquet was held Tuesday night. The average age of those present was estimated to be from 5 to 10 years higher than the average attending SPE or SPI meetings. Degrees were more in evidence than at American meetings. Papers were presented with greater care and in greater detail usually supported by slides and pictures.

Everyone was most cordial. I contacted Doctor Laeis, an S.P.E. Member who was coming to New York City to attend our SPE Annual Meeting but was prevented by cancellation of his visa under new Act.

Materials in Germany are more scarce than in USA. The same applies all over Europe. However one nowhere finds the buying hysteria which dominates the U.S.A.

At times the Technical German extended my limited supply but I enjoyed having been in Munich very much.

With most cordial good wishes I remain,

Yours very truly, Thos. E. Orr.

NEW YORK—NEWARK JOINT MEETING

Bess Day Is Guest Speaker

By A. M. MERRILL

The New York Section was host to the Newark Section at a joint dinner meeting on November 15 at the Hotel Shelburne. Approximately 95 members and guests of the two groups attended and heard a talk on "Application of Speed Nuts to Plastics" by H. R. Russell, general sales manager, and William Buttriss, sales production manager, of Tinnerman Products, Inc.

Mr. Russell began the talk by showing a sound film on Speed Nuts and their uses in reducing fabricating and assembly costs. Mr. Buttriss then gave a talk outlining the principles of spring-tension fasteners, their origin and history, the different types available, and their advantages and applications, using many slides of typical applications to illustrate his talk.

Mr. Buttriss noted that the principal problems in the fastening of plastics are: (1) fasteners must harness the cold flow of thermoplastics; (2) resilient fasteners with a greater load distribution area are needed for thermosets; and (3) fasteners must provide cheaper and faster assembly than obtained with metal inserts. Speed Nuts meet these requirements and are claimed to give assembly cost savings of 30-75% over other fastening methods. The speaker emphasized that while many types of speed nuts, clips, pins, rings, clamps, and retainers have become standardized, the company maintains a service department that is prepared to analyze fastening problems and, if necessary, develop new fasteners to meet any individual requirement.

Mrs. Bess R. Day, SPE executive secretary, attended the meeting as the guest of the two Sections, and spoke briefly on the activities of the national office in coordinating the work of the Society. Short welcoming addresses were given by New York president Sam Silberkraus, Riverdale Laboratory, and Newark president Russell B. Akin, E. I. du Pont de Nemours & Co., Inc. Plans for the New York Christmas party on December party on December 20 and future meetings were discussed by program chairman Winslow A. Ward, American Cyanamid Co.

Useful table favors were distributed through the courtesy of Frank Kennedy, Electronic Wave Products Co., and the meeting concluded with a drawing for door prizes contributed by G. Palmer Humphrey, G. P. Humphrey Plastics and New York Section vice president, and Mike Miller, Miller Plastics Co.

ROCHESTER HOLDS PANEL DISCUSSION

By C. F. VAN EPPS

The Rochester section met November 20 to hold a panel discussion on molding problems.

The board of experts consisted of I. Copland, J. Grabowski, G. Delaine, G. Erdle, W. Ross and E. Palmer.

Approximately one hour was spent in discussion of a molding problem submitted by Mr. Rice of General Products Co. The panel recommended lower pressure and larger gating to strengthen a part (gas grenade) molded of Bakelite #14111 so as to withstand a 10 ft. drop test on concrete.

For elimination of gas bubbles in a thermoplastic plug submitted by Mr. G. Smith, of Stromberg-Carlson Co., the panel recommended smaller gating, and longer runners by-passing the mold cavity and entering the cavity slightly to the rear. A runner extension was also suggested for removal of "cold slugs." The answer "boiled down" amounts to reduction of turbulance of the hot thermoplastic material.

Mr. G. Smith also requested comments on the possibility of gating on the inside of telephone handles rather than at the center or both ends of the handle to eliminate finishing operations. Mr. W. Ross, an expert on molding telephone handles, explained that because of the complexity of the core insert there would be mechanical difficulties in transferring thermosetting compound and removal of the sprue.

HALBROOK AT TOLEDO FOR LADIES NIGHT

By E. H. JOHNSON

The Toledo Section, Society of Plastic Engineers set aside the night of December 5, 1950 as Ladies Night.

The meeting was held at the Toledo Yacht Club with dinner at 6:30 P.M.

The subject "Molded Plastics in the Home" was timely and interesting with the speaker Mr. Francis E. Halbrook covering the field of melamine tableware, kitchen gadgets and children's toys.

Mr. Halbrook is Sales Manager of International Molded Plastics, Cleveland, Ohio. His past experience includes work at American Cyanamid and Interchemical Corporation. During World War II he was a paratrooper. He is a graduate of Williams College.

Details to insure one of the most interesting meetings of the year were handled by Mr. Robert Dunham, Owens-Illinois Glass Company, Mr. Frank Bosenberger of Plaskon Company, Mr. J. M. Little, J. M. Little and Associates, Mr. E. Sullivan, Owens Brush Company.

Penn Notes

By PAUL ROCHE

Last month brought an application for membership from Al Berry of Dow Chemical Co., Cleveland office. In addition to the intended benefits of our monthly meetings, the regular appearance of our prime vendors at the meeting is of very great benefit to all of us.

The plastics industry in general was saddened last month over the passing of George P. Fryling, founder of Erie Resistor Corp. of Erie, Penna. and a pioneer in fostering the injection molding field in its early days. Mr. Fryling was the father of G. E. Fryling and W. H. Fryling who comprise the present top management of that company.

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PROGRAM OF
THE SEVENTH ANNUAL MEETING
AND
TECHNICAL CONFERENCE

HOTEL STATLER, NEW YORK CITY
JANUARY 18, 19, 20—1951

CONFERENCE PROGRAM
Thursday, January 18

MORNING SESSION: Georgian Room. Presiding—Stanley Bindman, The Jamison Plastics Corp. and co-chairman of Conference Committee.

9:45—**"Underwriters' Laboratories' Viewpoint on the Use of Plastics."** Karl S. Geiges, associate electrical engineer, Underwriters' Laboratories, Inc., New York, N. Y.

BIOGRAPHY:

Mr. Karl S. Geiges received a B.S. in electrical engineering from the Newark College of Engineering in 1928, and an M.S. degree from Stevens Institute of Technology in 1943. He has been with the U.L. since 1928, when he started as an assistant electrical engineer. He took a leave of absence during 1942 and 1943 to serve as electrical consultant to the War Production Board, and was assistant to the Navy Chairman of the Joint Army - Navy Specification Board during 1944-1945. Since 1946 he has closely followed postwar applications of plastics in the electrical industry in his present position.

ABSTRACT:

The application of plastics in equipment listed by Underwriters' Laboratories is of concern both from the standpoint of mechanical and electrical properties for doing the job at hand, and also from the standpoint of flammability which, in general, should be kept to a low level for minimum fire hazard. There is also a new problem which was largely introduced by the development of thermoplastics; namely, the effect of softening under moderate amounts of heating.

These two features cover the primary interest of U.L. engineers in the plastic applications. The relationships of materials that have balancing characteristics have received considerable study which, in turn, has been responsible for recognition of the newer plastics having special and highly desirable characteristics.

10:30—**"Properties, Applications, and Processing of Rigid Vinyls."** C. E. Parks, manager of Product-Development Laboratory, B. F. Goodrich Chemical Co., Cleveland, Ohio.

BIOGRAPHY:

Mr. Parks received his B.A. from Georgetown College in 1931, then taught chemistry and mathematics in Kentucky high schools. In 1939 he received his M.S. in organic chemistry from the University of Louisville. He joined Goodrich Chemical in 1942 as chief chemist of their Louisville Geon plant. Since 1949 he has been manager of the company's Product-Development and Customer Service Laboratories in Cleveland.

ABSTRACT:

High molecular weight polyvinyl chloride has excellent properties for rigid thermoplastic applications, but is generally considered to be too difficult to process. This paper reviews the early attempts to correct the processing difficulties by adding small amounts of plasticizer, and presents data to show that this causes a significant loss in physical properties. Also included in this survey is a discussion of low molecular weight copolymer resins which can be processed without plasticizer.

A new high molecular weight polyvinyl chloride resin is described which has much wider application possibilities because of its added toughness and higher temperature softening point. It can be processed satisfactorily on conventional equipment without the aid of plasticizers. Several applications are suggested which require the good physical and chemical properties of a high molecular weight unplasticized polyvinyl chloride plastic.

11:15—**"Plastics Industry in Great Britain."** Howard Vincent Potter, chairman and managing director of Bakelite, Ltd., London, England. Representing the British Plastics Federation.

BIOGRAPHY:

Mr. Potter received his early education at University School, Hastings, Sussex, and in 1908 entered the School of Pharmacy, Bloomsbury Square. In both 1908 and 1910 he won Silver Medals from the Pharmaceutical Society. In 1910 he became a junior chemist in the laboratories of Wright, Layman and Umnoy, Ltd., Southwark, and did research on drugs. In 1913 Mr. Potter received his B.S. degree in chemistry from King's College, London University, and became a student demonstrator in the Chemical Department of the College.

In 1914 he went with Damard Lacquer Co., Ltd, as a chemist working on phenol-formaldehyde condensation products. He was made manager of the company late in 1914, a director in 1921, and in 1927 was appointed managing director of Bakelite, Ltd., upon the amalgamation of Damard, Mouldensite, Ltd., and Redmanol, Ltd. He is a member and has held many offices with the British Plastics Federation, the Council of the Society of Chemical Industry, and the Plastics Group of the Society of Chemical Industry.

ABSTRACT

An outline will be given of the general organization of the plastics industry in Great Britain, including the functions of some of the trade and scientific groups such as the British Plastics Federation, The Plastics Institute, the Society of Chemical Industry (Plastics and Polymer Group), the Association of British Chemical Manufacturers, and the Association of Chemical and Allied Employers (Plastics Group). The relationships of these groups to the development and working of the British plastics industry will be discussed in some detail.

The paper will also include a discussion of the raw materials position, the expansion of the British plastics industry during recent years, probable future trends of the industry, the functions of some other groups connected with the plastics industry, and some statistics on the industry in great Britain.

12:00 noon—SPE ANNUAL LUNCHEON AND BUSINESS MEETING (for members only): Grand Ballroom. Presiding—C. Todd Clark, F. Burkart Mfg. Co. and SPE 1950 national president.

Luncheon speaker—Frank H. Carman, in charge of plastics materials activities for the Manufacturing Chemists' Association, Inc., Washington, D. C.

Title of address—"Materials Supply Prospects in 1951."

BIOGRAPHY:

After his graduation from the University of Akron in 1925, Mr. Carman was employed by B. F. Goodrich Co. in the compounding and development of industrial rubber products. From 1936-1941 he was in charge of rubber development and sales service in the central technical laboratories of Armstrong Cork Co. In 1941 he joined the War Production Board as a dollar-a-year man to handle priorities and other matters in connection with neoprene, and later with synthetic rubbers and vinyl. In 1942 he became chief of the Plastics Section of the WPB Chemicals Bureau. Mr. Carman became general manager of the Plastics Materials Manufacturers Association, Inc., in 1944, and assumed his present position in June, 1950, with the consolidation of P.M.M.A. and M.C.A.

ABSTRACT:

This paper will stress the importance of basic chemicals and the supplies of these chemicals to the plastics industry. It will be emphasized that these chemicals are becoming an ever more important and controlling factor in our materials supply. Although production of plastics is running at extremely high levels and capacity has been expanded greatly since World War II, the industry is still short for many important uses. Probable effects of mobilization as it may be accelerated in the early part of 1951 will be forecast insofar as possible.

Thursday Afternoon

AFTERNOON SESSION: Georgian Room. Presiding—Dr. Russell B. Akin, E. I. du Pont de Nemours & Co., Inc., and 1950 president of Newark Section, SPE.

3:45—**"A Family of High-Speed Thermoset Plastic Molding Materials."** Michael A. Brown, Jr., manager of sales promotion department, Plaskon Division, Libbey-Owens-Ford Glass Co., Toledo, Ohio.

BIOGRAPHY:

Mr. Brown has been in the plastics industry since receiving his B.S. in 1939 from the University of Pennsylvania. From 1938-1939 he was associate editor of "Modern Plastics" magazine, and in 1940 joined the Plastics Division of Monsanto Chemical Co. and served in various positions at Springfield, Mass., St. Louis, Mo., and Marshall, Tex. In 1945 he was co-author with John Sasso of "Plastics in Practice" (McGraw-Hill). He was editor and asst. publisher of 'Plastics' magazine, and in 1948 assumed his present position with Plaskon.

ABSTRACT:

1930-1939 was the decade of thermoset plastics and marked the introduction and development of ureas, melamines, cast phenolics, and the rounding out of phenolic molding materials. 1940-1949 was the decade of the thermoplastics, with extremely rapid growth in the plastics industry marked largely by phenomenal expansion in styrenes, acrylics, vinyls, and other thermoplastics.

New growth in thermosets depends on the development and acceptance of new materials, new equipment, and a basically new approach to the techniques of fabricating thermoset materials. The problems faced today by the thermoset plastics which must be solved in order to assure continued growth are: (1) develop materials and methods that will enable compression molding to compete economically with injection and extrusion molding; (2) develop methods of fabricating economically very large parts with high strengths without exorbitant increases in the size and massiveness of molding or fabricating equipment;

and C... develop materials which will present physical properties to enable plastics to serve where no plastics are now acceptable.

A start has been made toward the solution of these problems. Molding materials with fabricating characteristics quite different from those applied to standard thermoset materials are now available and are in commercial use. Work is progressing on adding to the family of materials based on polyester resins which have molding characteristics permitting an attack on the basic problems outlined above.

4:30—**"Molding and Extrusion of Teflon."** David D. James, product specialist in Field Service Laboratory of E. I. du Pont de Nemours & Co., Inc., Arlington, N. J.

BIOGRAPHY:

Mr. James graduated from the mechanical engineering course at the University of Pennsylvania, where he was a member of Tau Beta Pi, Sigma Tau, and the Hexagon Senior Society. During the war he served with the Navy as an electronics officer. Since joining Du Pont, he has specialized in the extrusion of nylon, polythene, and Lucite, as well as in the molding and extrusion of Teflon.

ABSTRACT:

Teflon is one of the most unusual plastics developed in recent years. Its outstanding chemical and physical properties have created wide interest in this new engineering material. Industrial uses of Teflon are based on its temperature resistance, chemical inertness, electrical properties, and non-adhesive characteristics.

The fabrication of Teflon is related to powdered metal techniques. In molding, the polymer is preformed, baked, and then cooled under pressure. When maintenance of close dimensional tolerances on a molded part is necessary, the baked piece is coined while still hot.

Teflon can be extruded by means of a screw or ram extruder into rods and tubes of various sizes. In extrusion, unlike other plastics, the screw or ram compacts under no heat into long-land dies where sintering is accomplished.

The method used for coating electrical conductors depends on the required wall thickness of the Teflon. Thick walls are produced by screw extrusion of granular polymer. Intermediate wall thicknesses are made by ram extrusion of a lubricated dispersion of the polymer. Very thin walls can be coated on wire by dipping the wire into a Teflon suspensoid.

Friday, January 19

MORNING SESSION: Georgian Room. Presiding—James C. Growley, Celanese Corp. of America and co-chairman of Conference Committee.

9:30—**Panel discussion on "Injection Molding Machines of the Future."** Moderator—Islyn Thomas, president of Thomas Mfg. Co., Newark, N. J.

Panel Members—J. F. Hronek, sales and service representative, Plastics Division, Fellows Gear Shaper Co., Springfield, Vt.

David J. Sloane, vice president of Lester Engineering Co., Cleveland, Ohio.

Albert Spaak, chief engineer of DeMattia Machine & Tool Co., Clifton, N. J.

George W. Whitehead, sales manager, Plastic Molding Machinery Division, Improved Paper Machinery Corp., Nashua, N. H.

James S. Wilson, manager of plastics machinery sales, Watson-Stillman Co., Roselle, N. J.

ABSTRACT:

Mr. Thomas will begin the discussion with a brief review of the history of injection molding machines since 1872.

Mr. Thomas will then submit prepared questions to the panel members for their answer and discussion. These questions are designed to elicit information on the probable future course of development of injection machines, including (1) future designs of heating cylinders; (2) standardization of machine components, such as radii on nozzles, platen sizes, etc.; (3) the relative values of toggle and hydraulic clamps; (4) preplasticizing; and (5) eventual size of machines.

Islyn Thomas

J. F. Hronek

Mr. Thomas

Mr. Thomas received his education at Johnson Technical School, Plastics Industries Technical Institute, University of Scranton, and Columbia University. From 1930-1942 he was employed by Consolidated Molded Products Corp. as draftsman, estimator, engineer, and then chief of the company's development division. In 1942 he went with Ideal Novelty & Toy Co. as general work manager and chief engineer until 1944, when he left to found his own company. He is the author of "Injection Molding of Plastics" (Reinhold Publishing Corp.), and was formerly an instructor on plastics at Polytechnic Institute of Brooklyn. He has held many offices in the Newark Section, and is 1950 national vice-president of SPE. He is also a member of SPI and the Plastic Sales Engineers.

Mr. Hronek

Mr. Hronek graduated from Williston Academy in 1937, and from Washington University in 1941. For the next three years he was a sales and service representative in the Detroit area, and for the past four years has represented Fellows in the New York and New England area.

David Sloane

Albert Spaak

Mr. Sloane

Born in New York City in 1919, Mr. Sloane graduated from Carnegie Institute of Technology in 1940 with a B.S. in mechanical engineering. He then was employed by the Trane Co., LaCrosse, Wis., and Pittsburgh, Pa., until 1941 when he entered the army. After receiving his army discharge in 1945, he joined Lester Engineering and worked in sales, service, and engineering until his recent election as vice-president of the company. Mr. Sloane is active in the SPE and is treasurer of the Cleveland-Akron Section.

Mr. Spaak

Mr. Spaak holds a degree in mechanical engineering from the Newark College of Engineering. He has been associated with De Mattia since 1938, rising to his present position as chief engineer. He is also an active member of SPE.

G. W. Whitehead

James S. Wilson

Mr. Whitehead

Mr. Whitehead received a B.S. in chemical engineering from the University of Nevada in 1927. He was employed by Hercules Powder Co. from 1927-1931 as development chemist and area supervisor. From 1931-1944 he worked as chemist and supervisor of technical sales for Fiberoid Corp. and its successor, Monsanto Chemical Co. He has been associated with Improved Paper Machinery since 1944.

Mr. Wilson

Mr. Wilson entered the plastics industry in 1917 when he joined General Electric Co. and worked in the plastics and ceramics department until 1932. From 1932-1942 he was with the Albany Billiard Ball Co. doing work on plastics, and became associated with Watson-Stillman in 1942 in the promotion of molding equipment.

11:00—"After-Treatment of Molded Polystyrene Parts." Charles T. Snyder, technical specialist in plastics, Koppers Co., Inc., Pittsburgh, Pa.

BIOGRAPHY:

After his graduation from Carnegie Institute of Technology with a B.S. in chemical engineering, Mr. Snyder joined Westinghouse Electric Corp. and did development, process, and application engineering in the Micarta Division. Upon entering the army during the war, he was assigned to the War Department as a plastics specialist and did plastics coordination work at the Signal Corps Engineering Laboratories at Ft. Monmouth, N. J. In June, 1947, he joined the Chemical Division of Koppers Co. as a technical representative, and was promoted to his present position in September, 1949. In his present capacity he is responsible for coordinating technical service and sales work with the development and engineering of experimental and new commercial materials.

ABSTRACT:

In order to cover all phases of the "After-Treatment of Molded Polystyrene Parts" it would be necessary to discuss annealing, destaticizing, painting, coating, machining, and fabricating operations. However, in order to narrow the scope of the subject, the phase concerning all the ramifications of annealing has been chosen. This choice has been made because high labor costs, material shortages, and keen competition in the plastics industry make the annealing method of saving parts very attractive.

Annealing, according to the dictionary, means to free from internal stress by heating and gradually cooling. Annealing of molded polystyrene parts similarly means to relieve, either partially or totally, the major stresses and strains set up in the part during injection molding, machining, fabricating, or by external loading. This is accomplished in polystyrene by controlled heating and cooling of the part.

Various mechanical means of accomplishing this relief of strains are possible, and are determined by the economies to be effected. A detailed consideration of the advantages and shortcomings is necessary to round out the picture. In addition, it is important to have a simplified control testing procedure available to demonstrate the effectiveness of the operation.

A review of the entire picture, including the advantages in the form of savings and the possible limitations, will provide justification for annealing molded polystyrene parts.

Friday Afternoon

AFTERNOON SESSION: Georgian Room. Presiding—Arthur S. Jacobs, Renwal Mfg. Co., and program chairman of Conference.

1:45—"Conditioning Phenolic Materials for Stability in Molding." Jerome L. Formo, supervisor of Plastics Laboratory, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

BIOGRAPHY:

Mr. Formo graduated from Augsburg College in 1937 with degrees in chemistry and education, then spent four years teaching high school sciences. He joined Minneapolis-Honeywell in June, 1941, as a chemist, then was transferred to the Methods Department where he worked with optical lenses and set up a lens cementing department. He was later asked to set up a plastics laboratory in the growing Plastics Division of the company. Over a period of years Mr. Formo has published many articles on various phases of plastics processing, and has presented papers before various industrial and professional societies.

ABSTRACT:

The effect of varied conditions in the steam preheating process has been studied with regard to volatiles produced during the preheating and molding operations, the mechanical and electrical properties of as-molded test pieces, and the long-time aging characteristics of molded phenolics.

Relationships are shown between moisture conditions in the preheating chamber and quantities of volatiles produced under a variety of conditions. Similarly, relationships are shown to exist between moisture conditions and various physical properties, including tensile strength, flexural strength, impact strength, shrinkage, and electrical properties.

The effect of long-time aging under various conditions indicates that exposure conditions after molding are of much greater consequence than conditions existing during the molding operation.

2:30—**"Polyesters."** Dr. Earle S. Ebers, sales manager of plastics and resins, Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.

BIOGRAPHY:

Dr. Ebers was born in Saskatchewan, Canada, in 1910. He received his B.S. in chemistry from Dalhousie University, Halifax, in 1931, and a Ph.D. in chemistry from Harvard University in 1936. He received a Canadian Royal Society fellowship for the study of infra-red spectroscopy at Ohio State University. Dr. Ebers joined U. S. Rubber in 1937 as a research chemist in the company's general laboratories at Passaic, N. J., and for the next nine years did fundamental and applied research on rubber and plastics. In 1946 he became manager of plastics development for Naugatuck Chemical, and in 1949 was named to his present position. He is a member of the American Chemical Society and is active in the SPE and the SPI.

ABSTRACT:

Polyesters are an outgrowth of the alkyd resins which are so widely used in finishes and protective coatings. The value of the alkyds is illustrated by their growth in consumption from 138,000 pounds in 1917 to about 138,000,000 pounds in 1944. The family of resins now known as polyesters were born in 1937. These resins consist of an unsaturated alkyd in combination with an unsaturated monomer. Although barely past the experimental stage, polyesters were put into full scale use during World War II and made many notable contributions. This paper will review the wartime contributions of the polyesters, their outstanding properties and methods of utilization in current products, and also attempt to forecast future developments.

3:15—**Symposium on "Distribution and Production Picture for Large Injection and Compression Moldings."** Four speakers from Plastics Division, Monsanto Chemical Co., Springfield, Mass., as follows:

Edmond D. Kennedy, manager of advertising and sales promotion; Edwin L. Hobson, sales manager—Thermoplastic Molding Materials; Frank J. Donohue, manager of Technical Service—Thermosetting Molding Materials; Sanford E. Glick, head of Technical Service—Thermoplastic Molding Materials.

ABSTRACTS:

Mr. Kennedy will direct the course of the discussion and introduce the other speakers.

Mr. Hobson will discuss present marketing of large moldings, such as in refrigeration, television, radio, luggage, and display signs. He will also discuss future developments in other fields, including furniture, air conditioning units, plumbing, architecture, etc.

Mr. Donohue will speak on design factors with large thermosetting moldings, as well as material properties.

Mr. Glick will note that although styrene was first used in the novelty field because of its low cost, it has gained increasing importance in industrial applications. Properties of styrene which stimulate this industrial trend include excellent dimensional stability, low moisture absorption, low specific gravity, uniform physical properties, non-retention of odor, resistance to attack by a wide range of chemicals and foodstuffs, and ease of molding.

Since plastics are organic compounds they inherently have a certain amount of instability of one type or another. These types of instability include: (1) zero stress dimensional stability (the effect of humidity, drying, and cycling when no load is applied); (2) heat distortion temperatures; (3) cold flow; (4) effect of temperature on physical properties; (5) water absorption; (6) volatilization of compound and plasticizers; and (7) presence of internal strain.

Additional information is presented on zero stress dimensional stability, heat distortion temperatures, flammability, and cold flow, as well as the effect of temperature on physical properties. Of particular importance for industrial applications are some of the more recent developments in materials. The heat resistant styrenes, high impact styrenes, and flame resistant styrenes are discussed. Photographs and diagrams illustrating the various applications are presented.

BIOGRAPHIES:

Mr. Kennedy

Mr. Kennedy received a B. A. degree from the University of Pittsburgh in 1933, and also studied at Carnegie Institute of Technology. His experience prior to joining

Monsanto includes advertising and promotional work with Westinghouse Electric Corp., National Electrical Products Co., J. Walter Thompson, Vickers Hydraulic Co., and Kopperweld Steel Co. He is a member of the SPI Informative Labeling Committee, and the editor of "How to Label Plastic Products . . . For Profit."

Mr. Hobson

A native of Richmond, Va., Mr. Hobson graduated from Massachusetts Institute of Technology in 1937 with a B.S. in chemical engineering, and from the Harvard Business School in 1946 with a Certificate of Business Management. He was a sales engineer with Bakelite Corp. and worked on the development of a market for polystyrene when it was first introduced. During the war Mr. Hobson served as a lieutenant colonel in the Office of the Quartermaster General as chief of the Plastics Section, Research and Development Branch. His work in directing and coordinating the technical program involving plastic materials was recognized by a citation from the Secretary of War. Mr. Hobson joined Monsanto in June, 1946, and is also a member of the American Chemical Society, Chemists Club, and others.

E. D. Kennedy

E. L. Hobson

Mr. Donohue

Mr. Donohue received a B.S. degree in 1927 and a chemical engineering degree in 1930 from the College of the City of New York. He was employed for two years by Bakelite Corp., and then served for two years as an instructor in general chemistry at C.C.N.Y. He went with the Resinox Corp. in 1934, and this firm became a part of Monsanto's Plastics Division in 1939.

Mr. Glick

After graduating from Massachusetts Institute of Technology in 1941 with a B.S. degree in chemical engineering, Mr. Glick joined Monsanto and spent five years in the Research Department doing development work on styrene plastics, styrene copolymers, and related materials. He was transferred to the Technical Service Department in 1946. He has served on the SPI Wall Tile Committee, and is a member of the sub-committee working on a revision of the SPI Handbook. During the past year he has been chairman of the SPE Sub-committee on Injection Molding Techniques.

7:15—**ANNUAL BANQUET.** Grand Ballroom. Presiding—The new SPE national president for 1951.

After-dinner speaker—John P. Coe, vice president of United States Rubber Co., New York, N. Y., and general manager of the Naugatuck Chemical and Synthetic Rubber Divisions.

Title of address—**"Synergism."**

Banquet will be followed by a gala entertainment program and an evening of dancing.

Frank J. Donohue

Sanford E. Glick

BIOGRAPHY:

Mr. Coe was born in Rock Falls, Ill., in 1889. He entered the University of Kansas in 1907, and then transferred to Washburn College and received a B.A. degree in 1911. Two years later he was granted a B.S. in chemical engineering from Massachusetts Institute of Technology. Immediately after graduation, Mr. Coe was employed by U. S. Rubber in its Indianapolis, Ind., plant and performed a wide variety of duties. In 1914 he was transferred to the company's general laboratories, then located in New York City. During World War I he worked in the Naugatuck, Conn., and Providence, R.I., plants on the development of an improved gas mask. He was later placed in charge of tire development, first at the general laboratories and, in 1927, in the tire division at Detroit, Mich. In 1931 Mr. Coe was made factory manager of the Naugatuck Chemical plant, becoming general sales manager of the Division in 1936, and general manager in 1939. When the company created the Synthetic Rubber Division during World War II, he was made head of that division. He was elected a vice president of U. S. Rubber in 1945. Mr. Coe is a member of the American Chemical Society, American Institute of Chemical Engineers, Commercial Chemical Development Association, Lotos Club, and the American Association for the Advancement of Science.

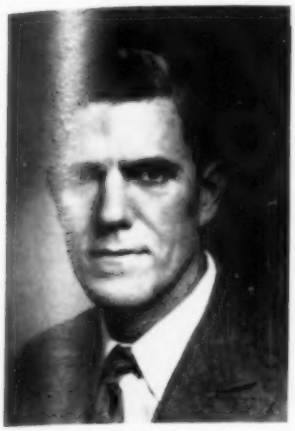
Saturday, January 20

MORNING SESSION: Georgian Room. Presiding—Samuel Silberkraus, Riverdale Laboratory and 1950 president of New York Section, SPE.

9:30—**"Plastisol Molding."** C. W. Patton, manager of coating and adhesive materials, Thermoplastics Department, Bakelite Division, Union Carbide & Carbon Corp., New York, N. Y.

BIOGRAPHY:

Mr. Patton graduated from Marietta College in 1932 with a B.A. degree, and shortly thereafter entered the research laboratories of the Carbide & Carbon Chemicals Division at South Charleston, W. Va. From 1937-1940 he was at the Mellon Institute of Industrial Research on a company fellowship, and from 1940-1942 was a development engineer in the Plastics Division of Carbide & Carbon Chemicals Corp. He has occupied his present position since 1942, following the acquisition of Bakelite Corp. by Union Carbide & Carbon and the merger of all plastics activities by the company.



ABSTRACT:

Mr. Patton plans to explain the background and operation of Plastisol molding. This will include— (a) Compounding. (b) Processing. (c) Different types of molding, including flush molding. (d) Examples of applications. (e) Trimming and finishing. (f) Decorating.

10:15—**"Designing Better Plastics Products."** Carl W. Sundberg, Sundberg-Ferar, Industrial Designers, Detroit, Mich.

BIOGRAPHY:

Mr. Sundberg has been designing products for the plastics industry for more than 16 years. Since 1948 he has worked with Hercules Powder Co. in a program of design assistance made available to users of cellulosic plastics in the planning of new products. Mr. Sundberg is a member of SPE and the Society of Industrial Designers, and is a frequent contributor to plastics industrial publications.

ABSTRACT:

The plastics industry has become design conscious. No other materials adapt themselves so well to the attractive modern shapes which plastics make possible. At the same time, plastics are ideal production materials since even the most intricate and complicated forms may be readily reproduced in unlimited number quickly and at low cost.

There are many different plastics and plastics processing techniques. The designer must be familiar with them all and be able to select the proper material and process for each individual job. The physical characteristics of the plastic materials are important, but so, too, are such considerations as material costs, adaptability to available manufacturing equipment, and, of course, appearance and style.

11:00—**"Masking Problems in Manual and Automatic Spray Painting of Molded Plastic Parts."** Hamilton E. MacArthur, treasurer and general manager, Conforming Matrix Corp., Toledo, Ohio.

BIOGRAPHY:

Mr. MacArthur, one of the founders of Conforming Matrix, has been developing, designing, and manufacturing paint masking shields, tools, and fixtures since 1938. He is a graduate of the Newark University Law College and a member of the New Jersey Bar. From 1929-1931 he was executive secretary of the International Association of Electrotypers and Stereotypers. He then returned to law practice at Newark until 1936, when he became associated with Atlas Electrotype & Stereotype Co. He is now vice president and a director of this company, and is also a member of the executive committee of Lexomar, Inc.

ABSTRACT:

The paper will begin with a review of long established masking practices using tape, die-cut adhesives, silk screening, hot stamping, printing, rolling, and hand worked sheet metal masks. There will also be a discussion of metal masks used in spray painting decoration, both fabricated and electro-formed masks. Recommendations will be made concerning the proper selection of the three general types of electro-formed masks, as follows: (1) the lip type to paint depressed letters or designs; (2) the plug type to paint relief or raised areas; and (3) the block cut-out type to spray decorate areas too small for practical precision masking, thereby necessitating some wiping.

The paper will also include suggestions as to when holding and pressure fixtures are desirable; comments on design of the part and mold so as to reduce costs in the painting of the part; and remarks on machinery.

11:45—**Presentation of prize-winning papers in the SPE 1950 Prize Papers Contest.**

SESSION MODERATORS

Dr. Russell B. Akin

A native of Warren, R. I., Dr. Akin received a B.S. in chemistry from Brown University in 1933, and M.A. in chemistry and chemical engineering from Columbia University in 1935, and a Ph.D. in chemistry from Columbia in 1937. He has been with E. I. du Pont de Nemours & Co. since 1937, serving first as a research chemist, becoming a production chemist in 1939, a technical service engineer in 1941, and in 1949 being appointed to his present position as assistant to the sales manager of the Polychemicals Department. His work with Du Pont has covered vinyls, acrylics, nylon, cellulosic plastics, and polythene. Dr. Akin is a member of many technical societies, and is 1950 president of the Newark Section, SPE.

Stanley Bindman:

Born and raised in New York City, Mr. Bindman received a bachelor's degree in chemical engineering from Cooper Union in 1941, graduated from the Plastics Industries Technical Institute in 1946, and received a professional mechanical engineer's degree from Cooper Union in 1949. From 1937-1941 he was a tool designer for H. K. Metalcraft, was production manager of Burchell Products from 1941-1945, and from 1944-1945 was chief engineer for Astor Ramel Corp. He was manager of manufacturing of the decorative lighting and toy division on Noma Electric Corp. from 1945-1950, and in February 1950 became president of Gemloid Corp., custom injection molders. Mr. Bindman is active in the New York Section of SPE, having been president in 1949, and is co-chairman of 1951 conference committee.

Sam Silberkraus

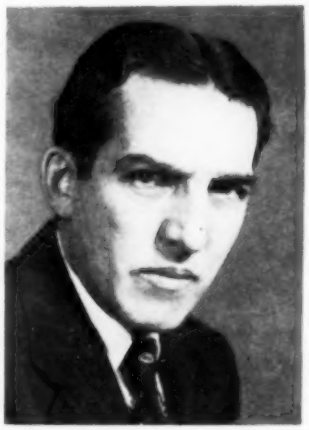
Mr. Silberkraus received a B.S. in chemistry from Union College in 1934, and has taken some graduate work at Polytechnic Institute of Brooklyn. From 1929-1930 he was with the Textolite Division of General Electric Co. He went with Resinox Corp. in 1935 as a research chemist working on thermosetting materials, and continued in this work under Monsanto Chemical Co. until 1942. From 1942-1944 he was plant manager of Richard Alan Button Co., and in 1944 organized Regal Molding Co. and became secretary-treasurer of the company. He disposed of his interest in Regal in 1949, and organized Riverdale Laboratories for the development of processes for the plastics industry. He is active in SPE and is 1950 president of the New York Section.

Arthur S. Jacobs

A native of New York City, Mr. Jacobs attended Pratt Institute and received a B.S. in mechanical engineering from the College of the City of New York in 1942. In 1942 he joined Sperry Gyroscope Corp. as a design engineer, and left that company in 1944 to become a sales engineer for Celanese Plastics Corp., a position he held until 1946. Since 1946 he has been associated with Renwal Mfg. Corp. as director of design and development. Mr. Jacobs has had wide experience with injection molds and molding materials, and has been active in the New York Section of SPE.

Carl Frosch

Carl J. Frosch received his B.S. in chemistry from Union College in 1929, and immediately joined the technical staff of Bell Telephone Labs. He attended a summer course in colloid chemistry at Massachusetts Institute of Technology in 1934. His work at Bell Labs. has been on the following: wood preservation, 1929-1934; high molecular weight organic polymers, 1934-1940; fabrication and development of plastics, 1940-1948; metallized paper capacitors, 1948; and semi-conductors, 1948 to date. He has published several articles, shared in the development of Paracon polyester rubber, and is a charter member of the Newark Section, SPE. He is a member of the editorial advisory board of SPE Journal.



James T. Growley

Born in New Brunswick, N. J., in 1916, Mr. Growley joined the plastics division of Celanese Corp. of America in 1936 as a member of the order department. He became sales representative in the Metropolitan area in 1939, and in 1941 transferred to the Pennsylvania, Maryland, and Virginia area. In 1945 he was transferred to the North Jersey area as a molding powder sales representative, and in 1949 was promoted to his present position as eastern sales manager of the division. Mr. Growley was 1949 president of Newark Section, SPE, and is co-chairman of the 1951 conference committee.

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THE MECHANICAL EQUATION OF STATE

WITH SPECIAL ATTENTION TO THE CREEP OF PLASTICS

By WILLIAM N. FINDLEY

Research Associate Professor of Theoretical and Applied Mechanics, College of Engineering, University of Illinois, Urbana, Illinois

Some of the conditions under which a mechanical equation of state may exist have been reviewed and tested in particular for a canvas laminated plastic.

In addition an equation has been developed which represents the creep behavior of canvas laminate and is in agreement with pertinent theory. From this equation for creep versus time at different stresses has been derived an expression for stress versus strain in a tension test at known rates of strain. The agreement between the predictions of this equation and the tension test data at different strain-rate histories lends support to the existence of a mechanical equation of state for this material. However, there are indications that at best the mechanical equation of state may be only an approximation.

It would be advantageous to be able to predict long-time creep behavior of plastics from the results of short-time tension tests. The idea of a mechanical equation of state for solids (similar to the thermodynamic equation of state for gases) as proposed by Ludwik[1] may be used to relate creep tests and tension tests in such a way as to allow prediction of one from the other. This idea considers that the stress is a function of the simultaneous values of strain, strain rate and temperature whether the test is an ordinary tension test or a creep test.

Suggested Forms of the Mechanical Equation of State:

Several investigators have proposed equations both theoretical and empirical for the mechanical equation of state.

The most promising of the theoretical equations were all based on the Boltzmann[2]-Maxwell probability distribution function:

$$p = C \exp(-\varepsilon / kT)$$

where T is the absolute temperature, k is a universal constant (the Boltzmann constant) and C is practically constant for relatively small variations in temperature.

In 1926 Becker[3] proposed a relationship which was further developed by Orowan[4] in 1936 and discussed by Kanter[5] in 1938. This theory was derived in terms of the shearing stress τ_o which must be developed in a small region in order that plastic flow might occur. The resulting equation (Becker-Orowan) for creep rate v at temperature T,

$$v = v_o \exp[-V(\tau_o - \tau)^2 / 2GkT]$$

was derived from the probability that a given region may acquire thermal fluctuations sufficient to raise the applied shear stress τ to the value τ_o.

A later approach to the problem revolved around the concept of the activation energy necessary for slip to occur. This theory was an extension of Eyring's equation for the viscosity of a liquid,[6] to creep of metals. The development was initiated by Condon[7] in 1936, extended by Kauzmann and discussed by Dushman et. al.[8] and by Findley.[9] The equation developed may be expressed in the form:

$$V = \frac{2}{3}\frac{\lambda}{L}\frac{kT}{h} \exp(S/R - Q/RT) \sinh\frac{qA\tau}{kT}$$

where S = entropy of activation per mole, Q = energy of activation per mole.

The Relationship Between Creep Tests and Static Tests:

If an equation of state is found to be valid within certain limitations then within these limits a material deformed under a constant stress (or constant load) to a given strain at which the strain rate has a certain value will have the same load or stress as a material deformed with a varying stress (or load) to the same strain if the strain rate at the strain is the same.

Thus it should be possible to derive constant-load creep curves directly from load-deformation curves obtained at known rates of straining.

Similarly it should be possible to derive constant-strain relaxation curves directly from the load-deformation curves.

A graphical procedure by which creep curves may be derived from load-elongation curves was suggested by Zener[10] and Holloman.[10,11] The curves illustrating this procedure (corrected slightly by the writer) are shown in Fig. 1. The load-elongation curves in Fig. 1a were determined from a series of tension tests at constant temperature but different rates of elongation. If a mechanical equation of state holds for the range of strains and strain rates selected the behavior of the material under a constant load may be derived (if tests at a sufficient number of strain rates are available) by drawing horizontal lines as in Fig. 1a and determining the elongations at intersection of these lines with the curves for different rates of elongation. The values of strain rate may then be plotted as in Fig. 1b. From this diagram the creep-time diagram, Fig. 1c, can be approximated by following the change in creep rate (slope of curve in Fig. 1c) with elongation.

Tension Tests vs Creep Tests for Cellulose Acetate:

An attempt has been made to determine whether the available data for cellulose acetate are in agreement with

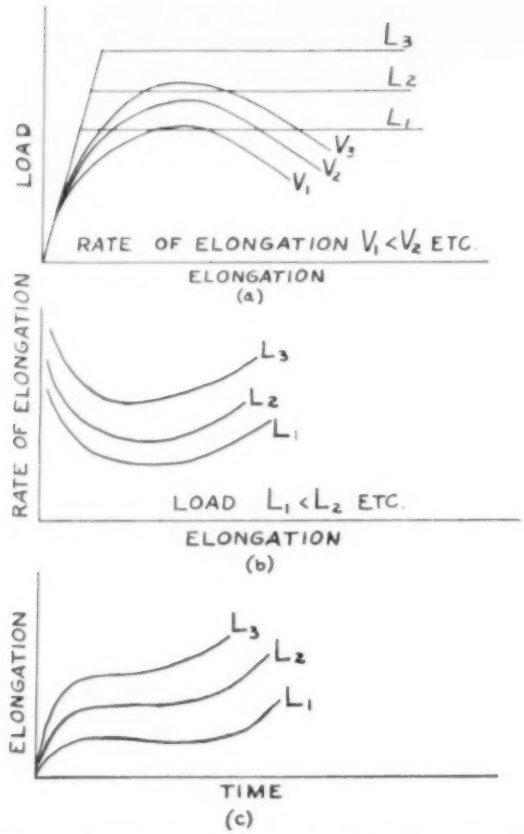

Figure 1. Derivation of Creep Behavior from Tensile Data, after Zener and Hollomon

the relations illustrated in Fig. 1; that is, to determine whether the equation of state holds for some range of the variables.

The tension data reported by the writer[12] for tests at several rates of strain were analyzed to determine the strain at a stress of 2700 psi for the tests at different rates of strain. These were compared with the creep rate from a creep test at the same stress. Unfortunately the strain rates available in the tension tests were not low enough and the amount of data available in the creep tests in regions of high creep rate and high stress was insufficient to permit an accurate comparison. It was only possible to establish that the creep rate and rate of strain were of the same order of magnitude at the stress and strain which were nearest to being common to both types of test.

In a previous paper[9] the writer showed that the creep for a grade C canvas laminate (and several other plastics) could be represented by the empirical equation.

$$\varepsilon = \varepsilon_o + m\,(t\ t_o)^n$$

for several stresses at 77 F and 50 percent relative humidity for over 2000 hr. of creep. In this equation ε_o and m are functions of stress and probably temperature, t_o is a constant (conveniently taken equal to unity) and n is a constant which was found to be independent of stress but may be a function of temperature. This equation is a straight line when log $(\varepsilon = \varepsilon_o)$ is plotted as a function of log t as shown in Fig. 2.

The factors ε_o and m were found to be approximately equal for equal stresses. Hence their stress dependence may be expressed by the same equation. A re-examination of this data discloses that ε_o and m may be represented reasonably well by the hyperbolic sine equation,

$$\varepsilon_o = m = \dot{\varepsilon}_o \sinh \dot{o}/\dot{o}_o$$

where $\dot{o}$ is the tension stress, $\dot{\varepsilon}_o = 0.00292$ in./in. and $\dot{o}_o = 5230$ psi are constants. (See Fig. 3.)

In another paper[9] the writer and collaborators presented data on the creep characteristics of a canvas laminate at three temperatures but constant relative humidity. This laminate was similar to the first except that it was molded at a low platten pressure. In this paper it was shown that the temperature dependence of the creep rate of the canvas laminate was in agreement with the prediction of the theoretical equation (3); and the values of activation energy Q, activation entropy S and product qAl were evaluated. It seems reasonable to expect the grade C canvas laminate to have a similar temperature dependence. Thus the complete equation for creep rate might be written in terms of shearing stress τ as:

$$V = \frac{n}{t_o}\,(t\ t_o)^{n-1}\,\frac{2}{3}\,\frac{\lambda}{L}\,\frac{kT}{h}\exp(S/R - Q/RT)\sinh\frac{qAl\tau}{kT}$$

As written this equation suggests that the theoretical equation (3) was incomplete insofar as the terms involving t and n are concerned. It seems quite certain that this is so since the creep rate changes with time for all materials—at least in the early portion of the test.

If we now follow the reverse procedure to that suggested in connection with Fig. 1, the stress-strain relation in a tension test of canvas laminate may be calculated from the creep equation Eq. (4) with the limitations given by Eq. (5).

The following equation results after appropriate factoring:

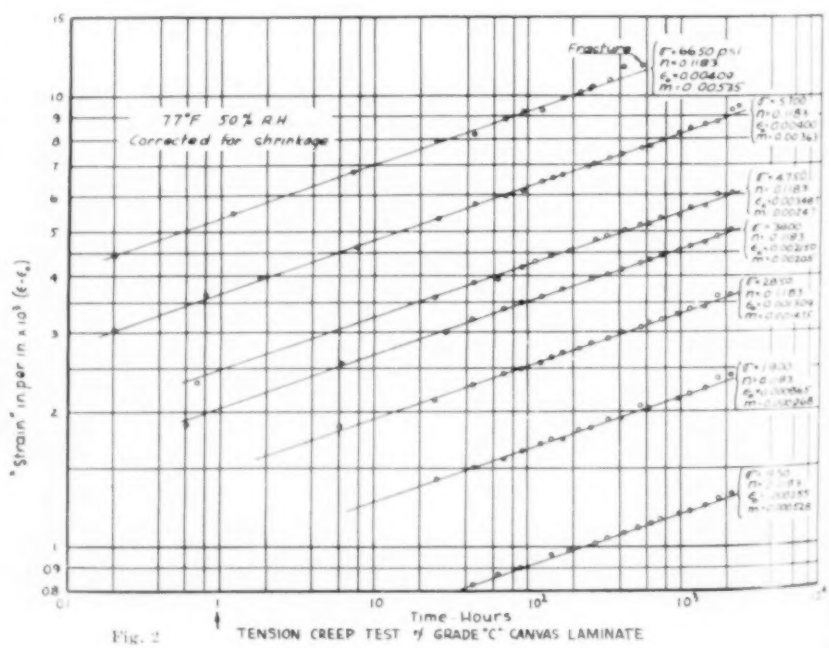
Fracture
77°F 50% RH
Corrected for shrinkage
"Strain" in par in. x 10^3 $(\varepsilon - \varepsilon_o)$
Time Hours
TENSION CREEP TEST of GRADE "C" CANVAS LAMINATE

Fig. 2

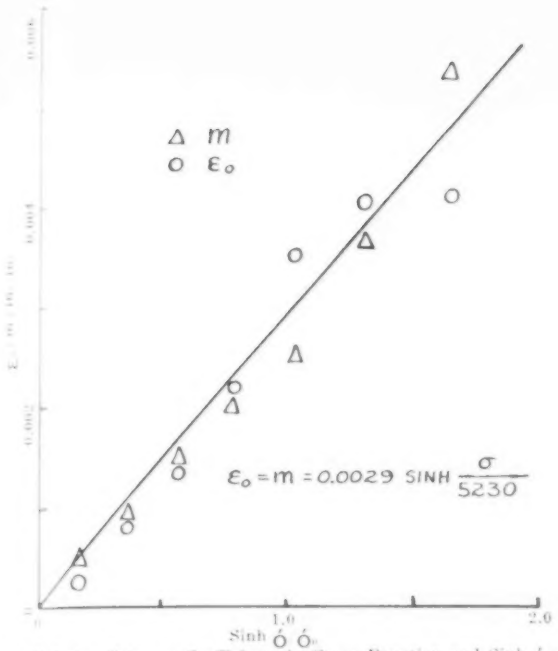

Fig. 3 Relation Between Coefficients in Creep Equation and Sinh $\dot{o}\ \dot{o}_0$

$$\varepsilon = \dot{\varepsilon}_0 \sinh \dot{o}\ \dot{o}_0 \left[1 + \left(\frac{\dot{\varepsilon}_0 n}{v t_0} \sinh \dot{o}\ \dot{o}_0\right)^{\frac{n}{1-n}}\right]$$

This is the desired equation for strain, ε, versus stress $\dot{o}$ in a tension test of canvas laminate conducted at the strain rate v expressed in terms of the constants for the creep equation for constant temperature.

The equation (7) may be tested against the initial tangent modulus of elasticity E by taking the derivative with respect to stress as follows:

$$\frac{1}{E} = \frac{\delta \varepsilon}{\delta \dot{o}} = \frac{\dot{\varepsilon}_0}{\dot{o}_0} \cosh \dot{o}\ \dot{o}_0 \left[1 + \frac{1}{1-n}\left(\frac{\dot{\varepsilon}_0 n}{v t_0} \sinh \dot{o}\ \dot{o}_0\right)^{\frac{n}{1-n}}\right]$$

At a stress $\dot{o}$ equal to zero equation (8) yields the relation

$$E = \frac{\dot{o}_0}{\dot{\varepsilon}_0} = 1.80 \times 10^6 \text{ psi.}$$

It may be of interest to note that Eq. (8) shows the slope of the stress-strain curve to depend on strain rate for all values of stress except at the origin at which location the stiffness is a property of the material and possibly temperature only.

The derived stress-strain equation (7) is shown in Fig. 4 in juxtaposition to the actual test data from a tension test of the laminate at a nominal rate of strain of about 0.1 in. in. hr. The derived curve however, was computed from the strain rate measured at given stresses from the actual data. This was done because the rate of strain was not constant during the tension test, as shown by the strain time curve in Fig. 4.

The agreement between the derived curve and the stress-strain test data constitutes an indication that the concept of a mechanical equation of state may be reasonably valid up to a stress of about 5000 psi. At this point the test data depart considerably from the derived curve.

Tests at Irregular Strain Histories:

Another test for the existence of a mechanical equation of state consists of

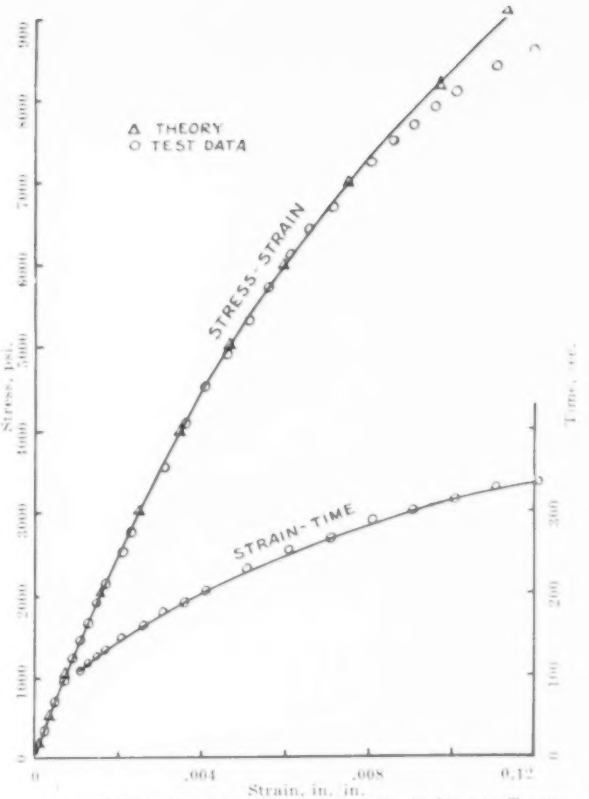

Fig. 4 Relation Between Actual Stress Strain Data in Tension and Equation Derived From Creep Data

comparing tests with different strain histories. Tension tests were performed at two different head speeds in an ordinary testing machine driven at a constant rate of crosshead motion. Then two other specimens were tested: one starting at the higher of the two speeds and changing in the middle of the test to the lower of the two speeds; the other starting at the lower of the two speeds and changing to the higher speed. The speed changes were made as rapidly as the equipment would permit.

These data are presented in Fig. 5 for tests of the same canvas laminate together with one of the strain

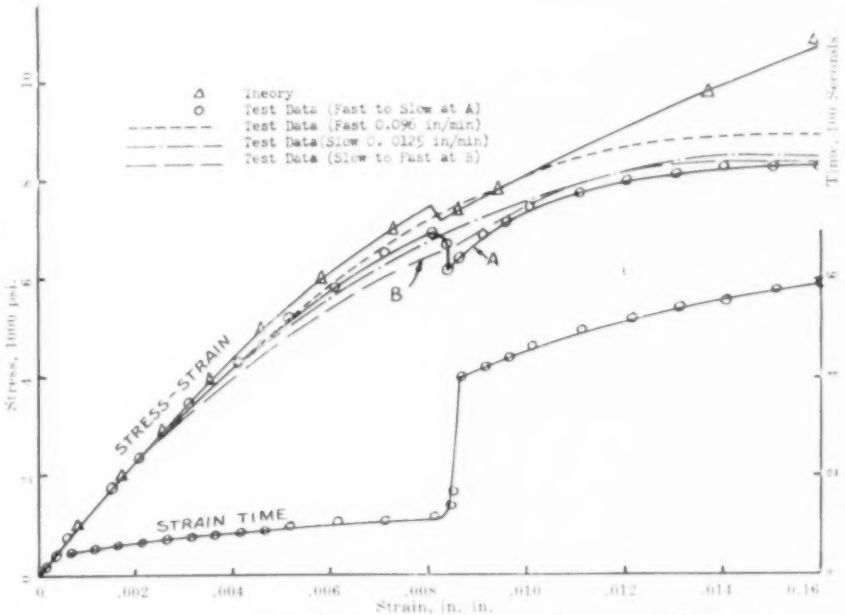

Fig. 5 Relation Between Actual Stress-Strain Data for Different Strain Histories and an Equation Derived from Creep Data

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Official Publication of The Society of Plastics Engineers, Inc. 409 Security Bank Building, Athens, Ohio.

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time curves. There are evidently some variations between the results that were not caused by the planned changes in strain rate. If allowances are made for these differences, the behavior is reasonably close to that required by the mechanical equation of state.

Equation (7) has also been used to derive an equation for a tension test with an abrupt decrease in strain rate corresponding to the time-strain curve shown in Fig. 5. The results, as presented in Fig. 5, show reasonably satisfactory agreement.

Acknowledgments:

The assistance of Messrs. Worley, Hendrickson, Chicoine, Anderson and Farrell in conducting the tests reported and performing computations is gratefully acknowledged. The project was carried out as part of the work of the Engineering Experiment Station, of which W. L. Everitt is the Director, in the department of Theoretical and Applied Mechanics, of which F. B. Seely is the Head. The author is also indebted to several of his colleagues for criticism of the manuscript.

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TORONTO HEARS OF POST-MOLD TREATMENT

By J. N. KEMPF

The Toronto Section of S.P.E. held its second meeting of the Fall Season in Room 1033, Wallberg Memorial Building, University of Toronto, the evening of November 10th, 1950 at 8:30 p.m.

After welcoming the guests to this second Fall Season meeting the Secretary called upon Graham Mitchell to introduce Mr. R. G. Rea, visiting Secretary of the Quebec Section to the members and guests present. Following this introduction the Secretary introduced Mr. Stanley R. Melvin of the Monsanto Chemical Company, Springfield, Mass. who was the guest speaker of the evening.

The speaker's subject for the evening was entitled "Post-Molding Treatment of Thermo-plastic Molded Items."

This elaborately prepared talk, accompanied by colored slides and sample displays was given for the first time at the National S.P.I. Conference at Swampscott, Mass., on October 20th and covers the broad field of post-molding treatments of thermo-plastic molded items under the following five main headings:

(a) Decoration. (b) Destaticizing. (c) Annealing (d) Assembly. (e) Metallizing.

Mr. Melvin emphasized that these various post-molding treatments increased the versatility, saleability and economy of thermo-plastic parts molded from the same cavities.

Decoration as a post molding treatment covered the field of lacquering by spray or dipping, silk screening wiping-in or roller-coating, continuous hot die stamping of roll leaf or foil, decalcomanias and rubber stamping. Many items employing each, or combinations of the above treatments, were projected on the screen illustrating their varied uses. Mr. Melvin then went on to explain the principles and techniques employed in destaticizing thermo-plastic molded materials. He explained the various destaticizing coatings and the principles on which they work. The coating, being a better conductor than the plastic drains the electrical charge from the dust particle as it is attracted to the molded part. Semi-permanent and permanent destaticizing coatings are available but much development work is still required to obtain better coatings for this purpose. He briefly mentioned radio-active destaticizers such as "polonium vapour" which is semi-permanent in that an opposite electrical charge is gradually built up on the surface of the plastic part.

Bindman Buys in at Jamison Plastics

Stanley Bindman has acquired a financial interest in the Jamison Plastics Corporation, 71 East Sunrise Highway, Freeport, Long Island, New York, where he is vice president and director. The New York office is at 11 West 42nd St. Telephone Longacre 4-0176. He was formerly President of Gemloid Corporation.